Essays on Motivation and Incentives: Theory and Experimental Evidence

Dissertation
submitted to the Faculty of Economics,
Business Administration and Information Technology
of the University of Zurich

to obtain the degree of
Doktorin der Wirtschaftswissenschaften, Dr. oec.
(corresponds to Doctor of Philosophy, PhD)

presented by

Lea Cassar
from Italy

approved in July 2015 at the request of

Prof. Dr. Roberto Weber
Prof. Dr. Nick Netzer

The Faculty of Economics, Business Administration and Information Technology of the University of Zurich hereby authorizes the printing of this dissertation, without indicating an opinion of the views expressed in the work.

Zurich, 15.07.2015

Chairman of the Doctoral Board: Prof. Dr. Josef Zweimüller

Acknowledgments

First and foremost, I would like to thank my supervisor Prof. Roberto Weber for always believing in me and in my work. The thesis strongly benefited from his guidance.

Second, I would like to thank Prof. Nick Netzer and Prof. Ernst Fehr for their many helpful comments and suggestions, which improved the thesis.

Third, I would like to thank my colleagues and friends, and in particular Holger Herz, Arnd Klein, Jean-Michel Benkert, Igor Letina, Frédéric Schneider, Donja Darai, Florian Zimmermann and Lea Heursen, for their professional but also psychological support throughout the easy and difficult times of the PhD. This experience would have not been the same without them.

Finally, a special thanks goes to my colleague and boyfriend, Florian Engl, not only for the above-mentioned reasons, but also for coloring my PhD time and for undertaking this adventure of life with me.

Contents

Chapter 1

Introduction

Broadly, my dissertation studies how social preferences affect the design of incentives and contracts in organizations. This includes studying how non-monetary incentives and, in particular, job characteristics such as impact on society (henceforth, the job's "mission"), can be part of a compensation package offered by an employer to attract and motivate his workers. This is the central topic of my dissertation, and in particular of Chapter 2 and 3. This broad area of my research also includes related work studying how notions of fairness and justice are shaped by experience. This is the central topic of Chapter 4.

Much empirical evidence shows that workers, especially those in the public or social sector, care about the mission of their job, in addition to their wage. My research uses theoretical and experimental methods to study how principals can use the choice of a project mission as part of a contract, to screen and incentivize such motivated agents.

In my second Chapter "Optimal contracting with endogenous project mission"[1], I study a model in which a principal selects an agent to develop a project and influences the agent's ex post level of effort not by outcome-contingent rewards, but by the choice of the project mission. The principal's and the agents' preferences about the mission are misaligned and the degree to which an agent cares about the mission is private information. I derive the optimal mechanism (allocation rule, project mission, payment) to select and motivate the agent. I show that under the optimal mechanism, the project mission is distorted towards the principal's ideal mission compared to the full information optimum. As a consequence, effort is lower. If the mission must be chosen prior to the allocation of the project, competition brings the principal to align the mission more with the agent's preferences, which increases his effort. Finally, in the presence of budget constraints, the principal should offer the same mission and the same payment to all types of agents. I then compare some of my predictions with existing empirical evidence on the bidding strategies used by profit and non-profit firms for the allocation of aid contracts. The model can be applied to the design and allocation of procurement contracts for the provision of social goods, to the design and allocation of research grants, and more generally to job design within organizations.

In my third Chapter, "Job Mission as a Substitute for Monetary Incentives: Experimental Evidence"[2], I ask whether principals use monetary and non-monetary incentives as substitutes

[1]This paper must be cited as: Cassar, L. (2014) "Optimal contracting with endogenous project mission" Working Paper.

[2]This paper must be cited as: Cassar, L. (2014) "Job mission as a substitute for monetary incentives:

in motivating effort. I address this question in a laboratory experiment in which the choice of the job mission is part of the compensation package that principals can use to influence agents' effort. Principals offer contracts that specify a piece rate and a charity – which can be either the preferred charity of the agent, or the one of the principal. The agents then exert a level of effort that generates a profit for the principal and a donation to the specified charity. My results show that the agents exert more effort than the level that maximizes their own pecuniary payoff in order to benefit the charity, especially their preferred one. The principals take advantage of this intrinsic motivation by offering lower piece rates and by using the choice of the charity as a substitute to motivate effort. However, I also find that because of fairness considerations, the majority of principals are reluctant to lower the piece rate below a fair threshold, making the substitution between monetary and non-monetary incentives imperfect. These findings have implications for the design of incentives in mission-oriented organizations and contribute to our understanding of job satisfaction and wage differentials across organizations and sectors.

A related area of my dissertation deals with how social preferences are influenced by experience with different kinds of incentive systems. Empirical evidence suggests that preferences for redistribution are not only driven by self-interest, but also by individuals' views on what is a fair distribution of income in society. The determinants of these fairness views are, however, largely unknown. In my fourth Chapter "A Matter of Perspective: How Fairness Views Depend on Relative Income" joint with Arnd H. Klein[3], we show that individuals' relative income, and how this income was generated – through a random lottery or a competitive tournament – affect their fairness views. This effect is such that low-income individuals redistribute significantly more than high-income individuals when the source of income differences is the same as the one they experienced themselves. We interpret this as evidence of a self-serving bias in responsibility attribution, which is supported by our data: compared to low-income individuals, high-income individuals tend to believe more that their outcome is the result of internal rather than external factors. Hence, having experienced more or less success based on a particular incentive and reward structure leads individuals to differentially interpret the fairness of that type of incentive. These findings are relevant for future theoretical and empirical studies on perceptions of fairness in organizations and, more broadly, on distributive justice: Fairness views about the distribution of rewards and income should not be treated as exogenous, as they are likely to be affected by individuals' own experience and income.

Experimental evidence" Working Paper.

[3]This paper must be cited as: Cassar, L. and Klein, A.H. (2014) "A Matter of Perspective: How Fairness Views Depend on Relative Income" Working Paper.

Chapter 2

Optimal Contracting with Endogenous Project Mission

Empirical studies show that workers, especially those in the public and social sector, are often driven only partly by financial rewards, but also by the mission of their job, i.e., by the overall job design and characteristics: the type of good that is provided, how it is provided, to whom it is provided, and so on.[1] This evidence suggests that the job mission can be used as a contracting tool by governments and employers of international, public or social organizations, to incentivize and screen their workers. To date, however, we know little about the role of the mission in optimal contracting for the provision of public goods and services.

In this paper, I analyze a mechanism design problem in which a principal must select one among many agents to develop a project and can influence the level of effort that the selected agent will put into the project not by outcome-contingent rewards, but by the choice of the project mission. The principal and the agents derive an intrinsic benefit from pursuing certain (observable) missions and therefore, from the project being designed in a certain way. The closer is the project mission to an agent's ideal mission, the higher is the level of effort that the agent will put into the project. The mission preferences of the principal and of the agents are, however, misaligned. This misalignment implies that in choosing a project mission the principal faces a trade-off between pursuing his ideal mission and extracting effort from the selected agent. The agent's effort is, indeed, observable ex-post but not contractible. Furthermore, the degree to which the agent cares about the mission is his private information, i.e., the agents have heterogeneous and unobservable intrinsic motivation levels. Thus, the principal faces, in addition, an adverse selection problem.[2]

I derive the optimal rule that should be adopted by the principal to select the agent and the optimal contract, consisting of a project mission and a payment, that should be offered to that agent. I also consider a simpler mechanism in which the project mission is fixed prior to

[1] Recent evidence includes Ashraf et al. (2014), Carpenter and Gong (2013), Gerhards (2013), Cassar (2014a). See Perry et al. (2010) for a comprehensive overview of the empirical literature on public sector motivation in the last 20 years and Francois and Vlassopoulos (2008) for a review of the theoretical literature on this topic.

[2] Importantly, the ideal missions of the agents are assumed to be equally distant from the principal's ideal mission. This means that the screening problem faced by the principal is uni-dimensional and refers to the agents' intrinsic motivation. Mechanism design problems where private information is multi-dimensional are hardly tractable and highly dependent on the exact parameters' values and functions' specifications (Asker and Cantillon (2010)).

the allocation of the project and, therefore, in which the principal only uses the payment to screen the agents. Finally, I study the same optimal contracting problem, but in the presence of budget constraints. In this setting, the agent's effort can be interpreted as the agent's ex-post financial investment into the project, whose costs must be covered by the principal's payment, i.e., the budget. This extension captures the contracting of public projects that are highly capital intensive, and where the agent has the expertise to make the investment but is not expected to financially contribute to the project. This is the case, for instance, in scientific and medical research projects or when the agent is an NGO with no access to independent resources. This extension, in addition to represent a novel theoretical problem, is of high relevance for the contracting over missions, because as it will be shown, the screening role of the mission is strongly tied to the principal's possibility of saving on the financial payments given to the agents with higher intrinsic motivation levels. When this possibility comes short, the mission fills solely an incentivizing role.

The analysis presented in this paper is relevant for a wide set of labor market environments where the mission of the job is part of the compensation package that a principal can use to select and motivate his employees. The model applies, for instance, to the design and allocation of procurement contracts for the provision of social goods and services. Governments and aid agencies regularly face the problem of selecting private organizations for the development of social projects in various fields (poverty reduction, education, health ...). Given that the contracts for the provision of public goods are often incomplete, the procurers must rely, to a large extent, on the unobservable intrinsic motivation of the selected organization's employees to put effort into the project. Furthermore, the procurer and the selected organization may not have identical preferences on how the project should be designed. Taking the example of an educational project, the government and the founders of a non-profit organization may have different views on the role of education and teaching methods: they may disagree on the educational curricula that should be taught, on how to select and pay the teachers, on whether to prioritize the quality versus the costs of education, on beneficiaries' targeting, on the role of religion in the school, and so on. Such "ideological" issues are frequently encountered in situations where non-profits are involved (Besley and Ghatak, 1999, 2001).

Similarly, the model can be applied to the design and allocation of research grants. Donors, such as public agencies or private foundations, must choose the allocation rule, the amount of the grant, and how many conditions to attach to the grant. These conditions typically concern the research questions that can be addressed, the research methods that can be used, and so on. The number of conditions and their level of detail will determine how much freedom the researcher will have to pursue his own research agenda, and in turn how much effort he will be willing to put into the project.[3] Thus, if donors have different, more policy oriented, research agendas than academics, they face similar trade-offs than the ones described in this paper.

More generally, this analysis applies to the optimal design of jobs within organizations where employees care about the level of discretion they are given in solving their tasks.[4] In this

[3]It is worth emphasizing that the model is not meant to formalize the allocation of grants as a form of prizes for the best project's proposal, as it is the case in Che and Gale (2003). In my framework, there are no sunk investments. The effort decision is only made by the winning agent after he has been allocated the project.

[4]This seems particularly relevant for those tasks that involve a certain level of creativity from the agent. Think for instance of a newspaper's director who needs to decide how much to pay his journalists and at the same time how much discretion to leave them in writing their articles. The newspaper may want to have strict rules on how articles should be written and on what topics should be covered. Journalists, on the other hand,

respect, the paper points to a different "hidden cost of control" which, contrary to Falk and Kosfeld (2006), Bartling et al. (2012, 2013), does not arise from the perception that the lack of discretion is a signal of the principal's distrust, but from the fact that workers have direct preferences on how to solve their tasks, and these preferences are not always aligned with the ones of their employers. In this setting it may be optimal for the principal to offer his employee a menu of contracts with different levels of wage and discretion and let the employee self-select in one of these contracts based on his intrinsic motivation level. This paper looks at the optimal menu of contracts to offer to the employee.

This paper belongs to the contract theory literature with motivated agents (Besley and Ghatak, 2005; Chau and Huysentruyt, 2006; Delfgaauw and Dur, 2007, 2008; Murdock, 2002; Benabou and Tirole, 2003, 2006). In an important part of the literature, the worker's intrinsic benefit of exerting effort has been assumed to depend on the (exogenous) intrinsic motivation level of the agent only. This intrinsic motivation varies across agents and is unobservable to the principal, leading to an optimal contracting problem with adverse selection.[5] These papers, however, do not model mission preferences. Therefore, the principal has no power of influencing the intrinsic motivation of the agents.

In the seminal paper by Besley and Ghatak (2005), principal and agents are assumed to derive an intrinsic benefit from pursuing certain missions: agents who work for a principal whose mission is closely aligned with their ideal mission, derive higher intrinsic benefit and thus, ceteris paribus, exert more effort, than agents who work for a principal with a different mission. The authors show that a principal can save on monetary incentives if he is matched with an agent who shares his same mission preferences. In their setting, however, the job mission is assumed to be exogenous[6] and motivated agents vary in their mission preferences rather than in how much they care about the project mission. Furthermore, in their model, there are no informational asymmetries and the matching of principals and agents is derived by an analysis of stable matching rather than by the derivation of an optimal allocation mechanism. This paper contributes to this literature by studying an adverse selection problem in the presence of mission preferences and by endowing the principal with a non-monetary instrument, i.e. the choice of the project mission, to influence the agents' motivation of exerting effort.

More generally, the paper also relates to those studies that analyze non-monetary devices to screen and incentivize agents with non-standard preferences. Previous studies have emphasized the role of status incentives (Besley and Ghatak (2008)), workers' identity (Akerlof and Kranton (2005, 2008)), bonus contracts (Fehr et al. (2007)), recruitment of biased workers (Prendergast (2007, 2008)), and reciprocal incentives (Englmaier and Leider (2012)).

Finally, the paper relates to the theoretical literature on delegation (e.g. Holmstrom (1984); Aghion and Tirole (1997); Alonso and Matouschek (2008); Armstrong and Vickers (2010); Frankel (2014)). This literature addresses the question of how to allocate the right to select actions or projects between a principal and an agent. In these models, however, ex-ante informational asymmetries between the principal and the agent, if any, do not refer to the agent's intrinsic motivation, but to the payoff-relevant state of the world or to the set of feasible

may want to write on what interests them the most and be free to choose their writing style.

[5]Studies that have looked at optimal contracting when agents vary in their intrinsic motivation include Francois (2003), and Delfgaauw and Dur (2007, 2008).

[6]The authors only briefly discuss the possibility of relaxing the assumption of exogenous job mission but leave the detailed analysis for future work.

projects.

In the benchmark model in Section 4, I show that under the optimal mechanism the principal makes a smaller compromise on the mission than the full information optimum. In other words, because the agents' intrinsic motivation levels are private information, it is optimal for the principal to set a project mission that is closer to his ideal mission - and thus more distant from the agent's preferences - compared to the case in which the principal could observe the agents' intrinsic motivation levels. As a consequence, the agent's effort is also lower. This distortion arises because the informational rent given to the agents with higher intrinsic motivation is increasing in the effort level of the agents with lower intrinsic motivation. This also implies that while under complete information the project mission is always closer to the agent's than to the principal's preferences, under asymmetric information this only holds true for the missions contracted with agents with sufficiently high intrinsic motivation levels. Finally, I show that the optimal mechanism can be implemented through a scoring auction[7] where agents bid a proposal for the project mission and a payment, and whose scoring rule over-penalizes a non-compliance of the agent's proposal with the principal's ideal mission compared to the principal's utility function. Under this scoring auction, agents with higher intrinsic motivation levels bid a lower payment and a project mission that is more distant from the principal' ideal mission, compared to the agents with lower intrinsic motivation levels. This prediction is consistent with the existing empirical evidence on the bidding strategies used by profits and non-profits for the allocation of aid contracts.

In Section 5, I derive the optimal mechanism if the project mission must be chosen prior to the allocation of the project. This means that the principal cannot condition the mission on the agent's type. I show that an increase in competition, defined as the number of agents competing for the project, brings the principal to align the mission more with the agent's preferences, which increases his effort. Also, I show that the project mission under this simpler mechanism is better aligned with the agents' preferences compared to the expected project mission of the mechanism described above, in which the principal can condition both the mission and the payment on the agent's type. This stems from the fact that, in the scoring auction, the agents are also competing along the mission dimension and these competitive forces drive up their expected ideological compromise.[8]

In Section 6, I analyze the same optimal contracting problem assuming the presence of budget constraints and one agent only. In this setting the principal's payment represents the budget available to the agent to develop the project, and the agent's effort can now be interpreted as the agent's ex-post monetary investment in the project. This means that the payment acts as an upper bound on the agent's investment, as it must cover its costs. This

[7]A scoring auction is a multi-dimensional auction that requires to bid on other variables in addition to the price. Bids are evaluated by a scoring rule designed and announced ex-ante by the auctioneer. The bidder with higher total score wins.

[8]While the effect of competition in private good procurement has been widely studied, no equivalent evidence exists in the context of social good provision with motivated agents. Theoretical contributions on the effect of competition between motivated agents have focused on private fund-raising (Aldashev and Verdier (2010); Aldashev et al. (2013)), matching with mission-oriented organizations (Besley and Ghatak (2005, 2006)), organizational choice (Ghatak and Mueller (2011, 2013)) and corporate culture (Kosfeld and von Siemens (2011)). An exception is Chau and Huysentruyt (2006), which studies non-profits' competition for a procurement contract. The authors show that a competitive tender for the allocation of public funds leads to an ideological compromise between the missions of the principal and the contracted non-profit. Their paper, however, does not derive the optimal mechanism and does not study the effect of competition by varying the number of competitors.

extension captures those situations in which a principal allocates a budget to an agent with expertise, who should then invest it in a public project. As contracts are incomplete, the amount of the budget that the agent will actually invest - rather than keep for personal consumption or waste - depends on the agent's intrinsic motivation and on the extent to which the mission of the project reflects his preferences. I show that in this setting the optimal contract is a pooling contract: the optimal project mission and the optimal payment are not contingent on the agent's intrinsic motivation level. In other words, it is not optimal for the principal to screen the agent. Compared to the main model, the principal can no longer save on payments by better aligning the project mission with the agent's ideal mission. As the project mission gets closer to the agent's ideal mission, the agent's investment increases, but only to the extent allowed by the payment-budget. That is, the ideological and the financial compensation are complements rather than substitutes. I show that for a separating equilibrium to be implementable, types with low intrinsic motivation levels must receive very high financial rents. This turns out not to be optimal for the principal.

2.1. The Model

Consider the following environment: a principal needs to allocate a contract to one among n motivated agents for the realization of an indivisible project. The contract specifies a project mission, m, and a payment, p. The agent who is allocated the contract (m, p) will then exert a level of effort, e, to develop the project. I assume the output of the project to be equal to the agent's effort. This coincides with assuming a linear production function $Y(e) = e$. Alternatively, e can be interpreted as the probability of a high output. To avoid confusion, throughout the paper I will only refer to the agent's effort rather than to the project's output. Consistent with many standard agency models for the provision of public goods,[9] due to contracts' incompleteness and non-enforceability of effort, the latter is assumed to be observable ex-post but not contractible.

Agents vary in their innate intrinsic motivation level, θ. Everything else being equal, agents with higher θ derive higher intrinsic benefit from putting effort into the project. Each agent only knows his own intrinsic motivation; the other agents and the principal perceive types as being independently drawn from a distribution function $F(.)$ on the interval $[0, 1]$. $F(.)$ is assumed to satisfy the monotone hazard rate property, i.e. $\partial[(1 - F(\theta))/f(\theta)]/\partial\theta < 0$.

The agents and the principal are endowed with different observable mission preferences, i.e. they disagree on what the project mission should be. Let's define by m_D the ideal mission of the principal and by m_i the ideal mission of agent i. I present here the simplest version of the model: m, m_D, and m_i are one-dimensional variables and missions preferences are homogenous across agents, i.e. $m_i = m_A \; \forall \; i$.[10] For the sake of notational simplicity let me standardize the

[9] I refer the reader to Francois and Vlassopoulos (2008) for a review of this literature

[10] As mentioned in the introduction, relaxing the assumption of agents' homogenous mission preferences would lead to a multidimensional screening problem that is not tractable in this setting. Because of the endogeneity of the direction in which the incentive compatibility constraints bind, the optimal mechanism design problem where private information is multidimensional is hardly tractable and, if it is, it depends finely on the exact parameters of the problem and cannot be implemented by standard auction format or other practical and simple contracting procedures, as also stated in Asker and Cantillon (2010). Therefore, it goes beyond the scope of this analysis.

missions' values to $m_A > m_D \geq 0$. It follows that the value taken by the project mission must lie between m_D and m_A, i.e. $m_A \geq m \geq m_D$.[11]

Formally, the agents' and the principal's preferences can be represented as follows. The utility of agent $i, i = 1, ..., n$ from winning the contract is given by

$$U_i(e_i; m, p) = p + \theta_i G(m_A - m)e_i - \psi(e_i) \tag{1}$$

$G(m_A - m)$ represents an *ideology function*, with properties $G'(m_A - m) < 0$, $G'(0) = 0$, $G''(m_A - m) < 0$. It is a function that increases as m gets closer to the agent's ideal mission m_A, or, more intuitively, it is a function that decreases in the distance between m and m_A, i.e. in the agent's ideological compromise. Notice that the intrinsic benefit derived from exerting effort - the second term in (1) - results from the interaction between the agent's exogenous intrinsic motivation level and the extent to which the project mission is aligned with his own ideal mission. As m gets closer to m_A, the utility that the agent gets from putting effort into the project increases. This increase is higher the larger is θ_i, i.e. agents with higher intrinsic motivation get a higher intrinsic benefit from a decrease in their ideological compromise. $\psi(e_i)$ represents the standard disutility of effort, $\psi' > 0, \psi'' > 0$. To allow for an explicit solution, I will assume that $\psi(e_i) = \frac{1}{2}e_i^2$. If the agent is not allocated the project, he receives a reservation utility $\overline{u}$.

The utility of the principal from contracting with agent i is

$$V_D(m, p; e_i) = \theta_D G(m - m_D)e_i - p \tag{2}$$

where θ_D is a fixed parameter capturing how much the principal cares about the project's output. $G(.)$ is the same function as for the agents in equation (1), but centered at m_D rather than at m_A. If the principal does not allocate the project, his utility is zero.

Figure (2.1) provides an example of the agents' and the principal's ideology functions. Notice that, in principle, $G(.)$ can also take negative values. If the project mission is too far away from one's ideal mission, there are intrinsic costs rather than intrinsic benefits associated with the development of the project. It follows that a necessary condition for the contract to be allocated is that the principal's and the agents' ideal missions are sufficiently close. Graphically, this means that the ideology function of the principal, $G(m - m_D)$, and the ideology function of the agents, $G(m_A - m)$, take a positive value at their crossing point. In the remainder of the paper, I will simply assume, as in Figure (2.1), that $G(m_A - m_D) > 0$.

It is worth mentioning that the model naturally extends to heterogeneous k-dimensional missions, provided that the distance between the k-dimensional vector m_D and the k-dimensional vector m_i is kept constant across agents: $d(m_D, m_i) = ||m_D - m_i|| = \overline{d} \quad \forall i$. In such a multi-dimensional setting, the principal would not contract a specific project mission m but rather a maximal allowed distance between the project mission and his own ideal mission, $d(m_D, m)$. It follows that once the contract has been allocated, the winning agent would be free to implement *any* project mission $m \in \mathbf{R}^k$ whose distance from the principal's ideal mission is equal or smaller

[11] As an explanatory example, suppose that the principal and the agents disagree on beneficiaries' targeting: while the principal would like an equal representation of beneficiaries from ethnic group A and from ethnic group B, the agents are only interested in helping ethnic group A. These mission preferences can be represented by defining the project mission as the percentage of beneficiaries from ethnic A. Then m_A will correspond to 100 and m_D to 50.

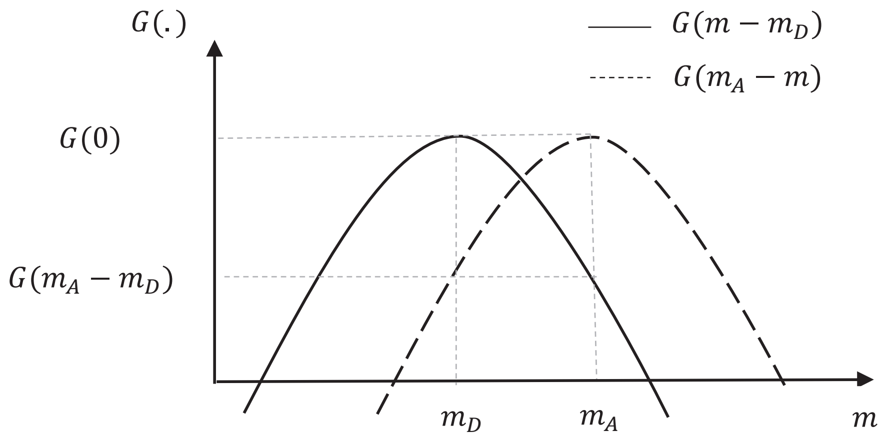

Figure 2.1

Ideology Functions

than the distance allowed in the contract. In practice, the choice of $d(m_D, m)$ would translate into a number of binding conditions about the project's characteristics that will be specified in the contract. The higher the number and\or the stronger the conditions, the smaller is $d(m_D, m)$. What is not specified in the contract would be left to the agent's discretion. Therefore, the contract can also be interpreted as one that allocates control over the project's design between the winning agent and the principal.

Given the contract (m, p), agent i chooses an effort level equal to

$$e_i^*(m, \theta_i) = \theta_i G(m_A - m) \tag{3}$$

This effort function is known to the principal. However, since θ_i is not observable, at the time of offering the contract the principal does not know the effort level that the agent will put into the project.

2.2. Full Information Optimum

Before proceeding to the model with asymmetric information, I characterize the full information optimum, which already generates some relevant insights. If θ_i were observable, the principal would select the agent with the highest intrinsic motivation level, choose the project mission that maximizes total surplus, and set the payment to make the agent's participation constraint bind, $U_i = \overline{u}$. More specifically, under complete information the optimal mission $m^*(\theta_i)$ and the optimal payment $p^*(\theta_i)$ satisfy respectively:

$$\frac{\theta_i}{\theta_D} = \frac{G'(m^* - m_D)}{G'(m_A - m^*)} - \frac{G(m^* - m_D)}{G(m_A - m^*)} \tag{4}$$

$$p^* = \overline{u} - \tfrac{1}{2}\theta_i^2 G(m_A - m^*)^2 \tag{5}$$

This solution has two important implications. First, comparative statics reveals that $m_A - m_i^*(\theta_i)$ is decreasing in θ_i.[12] That is, the higher is the agent's intrinsic motivation level, the closer is project mission to the agent's ideal mission. This is not surprising as it follows directly from the interaction between the agents' ideology function and the intrinsic motivation level θ_i. Agents with higher intrinsic motivation levels are more responsive to a decrease in their ideological compromise, both in terms of a higher increase in their level of effort and of a higher increase in the intrinsic benefit that they derive from it. It follows that the higher is θ_i, the more the principal can save on payments by moving the project mission towards the agents' ideal mission. Essentially, the principal is giving an ideological compensation to highly motivated agents, and a financial compensation to agents with lower intrinsic motivation.

Second, under complete information the principal bears the biggest ideological compromise, that is, the project mission is always closer to the agent's ideal mission than to the principal's one.[13] The intuition for this result is simple. The principal's surplus consists of the product of two factors: the agent's level of effort put into the project and how much the principal values that level of effort. This product is, thus, maximized when the project mission is half way between the principal's ideal mission and the agent's ideal mission. On the contrary, the agent's surplus is maximized when the project mission is equal to the agents' ideal one. It follows, that the socially optimal mission is closer to the agent's than to the principal's preferences. In other words, by better aligning the project mission with the agent's ideal mission, the principal saves on the payments due to the agent.

Finally, it is worth mentioning that in a model in which the agents were varying in their ability, i.e. cost of exerting effort, rather than in the degree to which they care about the project mission, we would not obtain the same results. Indeed, in that case, agents with higher ability would still exert more effort than agents with lower ability, but the benefit they would derive from any single unit of effort would be the same as other agents. This leads to a first best project mission that is independent of the agent's type. Furthermore, the project mission would be better aligned with the preferences of the party who has a higher valuation for it.

However, the principal cannot observe θ_i. Thus, to select and incentivize an agent he uses the mechanism explained below. Without loss of generality, throughout the remainder of the paper I will set $\overline{u} = 0$.

[12] To see this, notice that if θ_i increases, the LHS in equation (4) increases, so the RHS in equation (4) must also increase, which means that either $G'(m_i - m_D)/G'(m_A - m_i)$ increases or $G(m_i - m_D)/G(m_A - m_i)$ decreases, or both. Since $G(x)$ is decreasing in x, $G(m_i - m_D)/G(m_A - m_i)$ gets smaller as $m_A - m_i$ decreases and $m_i - m_D$ increases. Similarly, since $G(x)$ is decreasing and concave, $G'(m_i - m_D)/G'(m_A - m_i)$ increases as $G'(m_i - m_D)$ decreases (i.e. becomes more negative) and $G'(m_A - m_i)$ increases (i.e. becomes less negative), that is, as $m_A - m_i$ decreases and $m_i - m_D$ increases. This implies that $m_i^*(\theta_i)$ is increasing.

[13] To see this, notice that because the LHS in equation (4) is always positive, $G(m_A - m)/G'(m_A - m) \leq G(m - m_D)/G'(m - m_D)$. Since $G(x)$ is decreasing and concave, this implies that $m_A - m \leq m - m_D$. Mind, however, that this result would not necessarily hold if the principal and the agents had different ideology functions $G(.)$.

2.3. Optimal Mechanism

Without loss of generality, I restrict my attention to direct and incentive compatible mechanisms. That is, I look for a mechanism that specifies a probability of winning the project $q_i(.)$, a project mission $m_i(.)$, and a payment $p_i(.)$ as functions of the agents' reported intrinsic motivation levels $(\hat{\theta}_1, ..., \hat{\theta}_n) = \hat{\theta}$, and that induces a truth-telling Bayesian Nash equilibrium, $\hat{\theta} = \theta$. For sake of notational simplicity, let $q_i(\theta_i)$, $m_i(\theta_i)$ and $p_i(\theta_i)$ define, respectively, $E_{\theta_{-i}} q_i(\theta)$, $E_{\theta_{-i}} m_i(\theta)$ and $E_{\theta_{-i}} p_i(\theta)$.

The principal's optimization problem under incomplete information is then

$$\max_{q_i(.),m_i(.),p_i(.)} E_\theta \Big(\sum_{i=1}^{n} q_i(\theta)\theta_D G(m_i(\theta) - m_D) e_i^* - p_i(\theta) \Big) \tag{6}$$

subject to

$$\theta_i \in \arg\max_{\hat{\theta}_i \in \Theta} U_i(\hat{\theta}_i, \theta_i) = E_{\theta_{-i}} \Big(p_i(\hat{\theta}_i, \theta_{-i}) + q_i(\hat{\theta}_i, \theta_{-i})\theta_i G(m_A - m_i(\hat{\theta}_i, \theta_{-i}))e_i^* - \tfrac{1}{2} e_i^{*2} \Big) \tag{7}$$

$$U_i(\theta_i) \geq 0 \tag{8}$$

$$e_i^* = \theta_i G(m_A - m_i(\theta)) \tag{9}$$

$$\sum_{i=1}^{n} q_i(\theta) \leq 1 \ \text{ and } \ q_i(\theta) \geq 0 \ \text{ for any } \ \theta, \ \ i = 1, ..., n. \tag{10}$$

where $U_i(\hat{\theta}_i, \theta_i)$ is the expected utility of agent i when he reports his intrinsic motivation level to be $\hat{\theta}_i$ and all the other agents report their intrinsic motivation levels truthfully, and where $U_i(\theta_i)$ is the agent's i expected utility when telling the truth. The incentive compatibility constraint in (7) then imposes that $U_i(\hat{\theta}_i, \theta_i)$ is maximized at $\hat{\theta}_i = \theta_i$, that is, it should be optimal for agent i to report his type truthfully. Equations (8), (9), (10) represent, respectively, the individual rationality constraint, the agent's ex-post optimal level of effort, and the basic properties of the probability function. The solution to this problem leads to the first proposition:

Proposition 1 *Under the optimal mechanism:*
a) The project is allocated to the agent with the highest intrinsic motivation:

$$q_i^*(\theta) = \begin{cases} 1 & \text{if } \theta_i > \max_{\forall j \neq i} \theta_j \\ 0 & \text{otherwise} \end{cases} \tag{11}$$

b) The project mission contracted with agent i satisfies:

$$\frac{\theta_i - 2\frac{1-F(\theta_i)}{f(\theta_i)}}{\theta_D} = \frac{G'(m_i^* - m_D)}{G'(m_A - m_i^*)} - \frac{G(m_i^* - m_D)}{G(m_A - m_i^*)} \tag{12}$$

c) The expected payment of agent i satisfies:

$$p_i^*(\theta_i) = \int_0^{\theta_i} E_{\theta_{-i}} \Big(q_i(t_i, \theta_{-i}) t_i G(m_A - m_i(t_i, \theta_{-i}))^2 \Big) dt_i - E_{\theta_{-i}} \Big(q_i(\theta) \tfrac{1}{2} \theta_i^2 G(m_A - m_i(\theta))^2 \Big) \tag{13}$$

Proof. See Appendix.

Proposition 1 deserves some comments. First, notice that the project is always allocated to the agent who has the highest intrinsic motivation level. Thus, there is no exclusion of types. Second, and more importantly, notice that equation (12) is equal to equation (4) with the additional negative term $-2(1-F(\theta_i))/f(\theta_i)$ on the LHS. This implies that, with the exception of the project mission of the highest type in the distribution, the project missions of all the other types are distorted towards the principal's ideal mission compared to the full information optimum. As a consequence, the ex-post level of effort of the winning agent is also lower.[14] This inefficiency arises because the informational rent that the principal must pay the agents with higher intrinsic motivation to prevent them from imitating agents with lower intrinsic motivation is a decreasing function of the ideological compromise of the agents with lower intrinsic motivation - as the first term in equation (13) suggests. Thus, by increasing the ideological compromise of the latter beyond the full information optimum, the principal saves on the informational rents. The project mission of the highest type is not distorted because no other type wants to imitate the highest type. Proposition 1 also implies that, contrary to the full information optimum, agents with $\theta_i \leq 2(1-F(\theta_i))/f(\theta_i)$ contract a project mission that is closer to the principal's ideal mission than to their own.

Notice, furthermore, that given the regularity assumption about $F(.)$, the LHS of equation (12) is still increasing in θ_i. Thus, the higher is the intrinsic motivation level of the winning agent, the closer is the project mission to his ideal mission, the lower is the payment, and the higher is his ex-post level of effort.

Finally, the higher is the weight that the principal attributes to output, θ_D, compared to payments, the closer is the project mission to the prefect mid-way compromise, $\frac{m_D+m_A}{2}$. This holds true for all agent's intrinsic motivation levels. So in other words, as θ_D increases, the optimal contract $(m_i^*(\theta_i), p_i^*(\theta_i))$ "converges" towards a pooling contract with mission $\frac{m_D+m_A}{2}$.

2.3.1. Implementation

How can the optimal mechanism be implemented in practice? By applying the results in Che (1993) to this model, I derive the next proposition:

Proposition 2 *The optimal outcome can be implemented through a first- or second-score auction whose scoring rule over-penalizes a non-compliance with the principal's ideal mission compared to the principal's (true) utility function.*

Proof. See Appendix.

A scoring auction is a multi-dimensional auction where agents bid on both the price and the project mission, and bids are evaluated by a scoring rule designed and announced ex-ante by the principal. The bidder with higher total score wins. More specifically, under the first-score auction the winner develops the project with the offered mission at the offered price. In the

[14] This is consistent with the standard adverse selection result of "no distortion at the top" and with previous theoretical literature with non-motivated agents and explicit incentive schemes. In a setting with both adverse selection and moral hazard, Laffont and Tirole (1987) and McAfee and McMillan (1987) show that under the optimal mechanism the level of effort is lower than under the full-information optimum.

second score auction the winner is required to match the highest rejected score in the auction - with no additional constraints attached on the combination of mission-price.

A scoring rule specifies the weights that are given to the price and to the mission in calculating the bidder's score. Proposition 2 suggests that the optimal scoring rule induces the agents to bid a project mission that is closer to the principal's ideal mission than under the full information optimum. This naturally follows from Proposition 1. In practice, this means that the optimal scoring rule includes an additional argument to the true utility function of the principal that subtracts a higher number of points as the distance between m and m_D increases. This argument represents the informational rent due by the principal to the agent in order to satisfy the incentive compatibility constraint.[15]

Consistent with the model, public and international organizations such as EuropeAid, USAID, the UK's Department for International Development, and the World Bank's International Development Association, often use scoring auctions to allocate aid contracts: In practice, at the launch of the tender, these organizations release the project's "Terms of Reference" (TOR) along with the scoring rule that will be adopted to evaluate each bid. The TOR is a document that describes in details the ideal project mission from these organizations' point of view. In terms of this model, it means that they announce m_D. Then, each competing candidates bid a price and a proposal on the project's design and characteristics. Finally, the procurer's designed scoring rule assigns a score to the offered price and to each aspect of the proposal on the extent to which it conforms with the specified TOR. The bidder with highest total score wins.

2.3.2. Empirical evidence

The model fits some recent empirical evidence regarding the bidding strategies used by profits and non-profits in scoring auctions for the allocation of aid contracts by the UK's Department of International Development (DFID). The data set analyzed in Huysentruyt (2011) was collected and constructed by the author at the DFID's office in Scotland. This data set includes detailed information about all the 457 aid service contracts that were allocated through scoring auctions between the period 1998 and 2003, including the terms of reference as well as the 1,222 bids that were made for these contracts. Among other things, the paper looks at how bidding strategies, contract outcomes and participation in specific tenders vary between profits and non-profits. The main results in Huysentruyt (2011) can be summarized as follows:

Fact 1 *Non-profits make bids that score on average 4 to 6 percentage points worse on their compliance with the DFID's terms of reference (TOR) relative to for-profits (holding the tender constant).*

Fact 2 *The overall prices proposed by non-profits are approximately* 60% *cheaper, on average, than the prices proposed by for-profits (holding the tender constant).*

These results are consistent with the model if we reasonably assume that workers in non-profit organizations have on average a higher intrinsic motivation than workers in for-profit organizations. Agents with higher intrinsic motivation are willing to sacrifice financial gains in favor of a higher level of control over the project mission. Therefore, they will bid a lower price for developing the project and will bid a project mission that is more distant from the principal's

[15]See the Appendix for a mathematical expression of the optimal scoring rule.

ideal mission. On the other hand, agents with lower intrinsic motivation prefer to comply more with the principal's ideal mission in order to receive higher payments. As a consequence, they will bid a higher price for developing the project and will bid a project mission that is closer to the principal's ideal mission. So overall, highly motivated agents are more likely to score less on the mission dimension and more on the financial dimension than agents with low intrinsic motivation.[16]

2.4. Optimal Mechanism with Ex-ante Fixed Mission

In this section, I analyze a simpler mechanism in which the project mission is fixed prior to the allocation of the project and, therefore, the agents are only screened based on the financial dimension. I then compare this simpler mechanism to the one described above. The optimization problem is the same as the one in Section 4, with the exception that now the project mission m cannot be conditioned on the agent's type θ_i:

$$\max_{q_i(.),m,p_i(.)} E_\theta\Big(\sum_{i=1}^{n} q_i(\theta)\theta_D G(m-m_D)e_i^* - p_i(\theta)\Big) \tag{14}$$

subject to

$$\theta_i \in \arg\max_{\hat{\theta}_i\in\Theta} U_i(\hat{\theta}_i,\theta_i) = E_{\theta_{-i}}\Big(p_i(\hat{\theta}_i,\theta_{-i}) + q_i(\hat{\theta}_i,\theta_{-i})\theta_i G(m_A-m)e_i^* - \tfrac{1}{2}e_i^{*2}\Big) \tag{15}$$

$$U_i(\theta_i) \geq 0 \tag{16}$$

$$e_i^* = \theta_i G(m_A-m) \tag{17}$$

$$\sum_{i=1}^{n} q_i(\theta) \leq 1 \ \text{ and } \ q_i(\theta) \geq 0 \ \text{ for any } \ \theta, \ \ i=1,...,n. \tag{18}$$

The solution to this problem leads to the following proposition:

Proposition 3 *Under the optimal mechanism:*
a)The project is allocated to the agent with the highest intrinsic motivation:

$$q_i^*(\theta) = \begin{cases} 1 & \text{if } \theta_i > \max_{\forall j\neq i}\theta_j \\ 0 & \text{otherwise} \end{cases} \tag{19}$$

b)The ex-ante chosen project mission satisfies:

$$\frac{E[Y_2^2]}{\theta_D E[Y_1]} = \frac{G'(m^*-m_D)}{G'(m_A-m^*)} - \frac{G(m^*-m_D)}{G(m_A-m^*)} \tag{20}$$

[16] It is worth mentioning that this evidence does not prove that the DFID is actually using the *optimal* scoring auction. Other non-optimal scoring auctions may lead to similar results, as long as non-profits care more about the mission than for-profit organizations. Rather, this evidence suggests that the model in Section 2 is a good representation of the aid contracting environment and of the preferences of the actors involved in that environment.

where $E[Y_1]$ and $E[Y_2^2]$ represent, respectively, the expected value of the first order statistic of n independently drawn θ_i and the expected value of the second order statistic of n independently drawn θ_i^2.
c) The expected payment of agent i satisfies:

$$p_i^*(\theta_i) = \int_0^{\theta_i} E_{\theta_{-i}}\Big(q_i(t_i, \theta_{-i}) t_i G(m_A - m)^2\Big) dt_i - E_{\theta_{-i}}\Big(q_i(\theta) \tfrac{1}{2}\theta_i^2 G(m_A - m)^2\Big) \qquad (21)$$

d) The optimal mechanism can be implemented through a (reverse) price-only auction with the ex-ante chosen project mission in (20) .

Proof. See Appendix.

Depending on the specific assumptions about the ideology function $G(.)$ and the distribution function $F(.)$, the optimal mechanism might lead to the exclusion of some types, which would be implementable by imposing a ceiling price in the price auction. Proposition 3 reports the results when the optimal mechanism does not lead to such exclusion, while the more general results can be found in the Appendix. But the main point is that while the principal always allocates the project if he can condition the mission on the winner's type, if the mission must be fixed ex-ante the optimal auction may require a ceiling price depending on the specification of the utility functions, so the project is not always allocated. The intuition for this difference is simple. The principal wants to prevent agents with higher intrinsic motivation from imitating agents with lower intrinsic motivation. If the mission must be fixed-ex ante, the principal can only use the price to screen the agents. In other words, he needs to give a higher financial rent to the agents with higher intrinsic motivation to make them reveal their true type. By excluding some of the agents with lower intrinsic motivation, the principal reduces the informational rents due to the higher types. If the mission can be determined with the allocation of the project, the principal has an additional instrument to prevent agents with higher intrinsic motivation from imitating the agents with lower intrinsic motivation. He can slightly increase the ideological compromise of the latter. So everything else being equal, in the mechanism with ex-ante fixed mission the principal needs to exclude a larger number of agents compared to the optimal mechanism where the project mission can be set ex-post.

More importantly, it can be seen that contrary to the mechanism described in Proposition 1, the optimal project mission in (20) depends on the level of competition, n. The intuition for this difference is in the amount of information available to the principal at the time in which he chooses the project mission. In both settings, the effect of competition is to alter the distribution of the selected types, i.e. the expected intrinsic motivation of the winner is increasing in n. However, if the project mission can be determined with the allocation of the project, it can be conditioned on the winner's type. Therefore, once types are realized, competition plays no additional role. On the contrary, if the project mission must be fixed prior to the allocation of the project, the principal, at that point in time, has only information about the expected value of the winner's type. So the choice of the project mission is based on that expected value and the latter is an increasing function of the number of competing agents. Comparative statics then leads me to the next proposition:

Proposition 4 *As competition increases, the project mission gets closer to the agent's ideal mission:*

a) $\lim_{n\to 2} m_A - m^* \geq \lim_{n\to\infty} m_A - m^*$
b) $\exists\ n_0$ *such that* $\forall\ n > n_0$*,* $m_A - m^*$ *is strictly decreasing in* n*.*
c) For the uniform and ***any*** *power function distribution* $F(\theta_i)$*,* $m_A - m^*$ *is strictly decreasing in* n*.*

Proof. See Appendix.

Competition reduces the ideological compromise of the selected agent, and thus increases his effort level. The main intuition for Proposition 4 is the following. A higher number of competitors increases the expected *intrinsic motivation* of the winner, namely the expected value of the first order statistic of n independently drawn θ_i, but increases even more the expected *intrinsic benefit* from developing the project of the second lowest bidder, namely the expected value of the second order statistic of n independently drawn θ_i^2. The former affects output, while the latter affects the payment due by the principal to the winner. Thus, roughly speaking, an increase in n shifts the weight in the principal's utility function from the valuation of output to the payment. Therefore, the higher is the level of competition, the higher is the utility that the principal can derive by saving on payments rather than by increasing his valuation of output. This can be achieved by moving the ex-ante chosen project mission closer to the agent's ideal mission.

Finally, by comparing the expected project mission across the two mechanisms I find the following:

Proposition 5 *Projects whose mission is determined ex-ante lead to a smaller expected ideological compromise of the agents and thus, to a higher expected level of effort, than projects whose mission is determined with its allocation.*

Proof. See Appendix.

Proposition 5 also holds when comparing the optimal scoring-auction with the optimal (reverse) second price-auction without ceiling price. Thus, the result does not depend on the exclusion condition. The intuition lies in the degree of competitiveness of the two mechanisms. When the project mission is fixed ex-ante, the agents are only competing along the price dimension. On the contrary, in the scoring auction the agents are competing along both the price and the ideological dimension, and the project mission is the result of competitive forces. This ideological competition between agents drives up their expected ideological compromise.

It is worth mentioning, however, that even if the agent's expected effort is higher when the project mission is fixed ex-ante, the principal is overall better off under the optimal mechanism described in Section 4. This raises the question of why price-only auctions with ex-ante chosen project mission are still used in practice to allocate some aid contracts. A reasonable potential explanation is that a scoring auction entails higher screening costs on the side of the principal, because a specific score has to be assigned to the mission dimension of each applicant's proposal, whereas under a price auction with ex-ante fixed mission, the principal only has to check that each proposal satisfies the conditions specified in the contract. Therefore, even if the principal gets an informational advantage by letting the mission be determined with the allocation of the project rather than fixing it ex-ante, as the number of competing agent increases, there is less uncertainty about the value of the intrinsic motivation of the winner, so this informational advantage decreases.

In the extreme case with $n \to \infty$, the principal knows with certainty the intrinsic motivation of the winner, so the optimal project mission will be the same whether it is set prior to, or with, the allocation of the project. In other words, if n is sufficiently large, the optimal scoring auction and the optimal price auction yield the same expected utility to the principal. It follows that if the principal expects a large number of applicants, the expected loss in utility of fixing the project mission ex-ante can be lower than the expected savings in screening costs, making the price competition more appealing than the scoring auction. This is all the more true, the lower is θ_D, that is, the lower is the weight that the principal assigns to output compared to the price. If θ_D is low, the principal mainly cares about lowering the price he has to pay for the project rather than about output. So in the presence of screening costs and high competition, it may not be worth running a scoring auction. Consistent with the stylized facts described below, this applies particularly well to the social goods that are covered by supply and work contracts (e.g. rental and hire products, building projects), whose implementation is, by nature, not very sensitive to ideological values. So the principal will mainly try to reduce the payment.[17]

2.4.1. Stylized facts and theoretical predictions

Contrary to social service contracts, supply and work contracts in the aid sector are allocated through a standard price competition, with ex-ante fixed project mission.[18] In practice, fixing the project mission ex-ante is equivalent to specifying, in the TOR, a minimum set of conditions on the project's design that ought to be satisfied. Therefore, the conformity of the applicants' proposal to these conditions is only made on a YES/NO basis. No score is assigned. Only those applicants that satisfy a sufficient number of conditions will be allowed to bid for a price. Among those, the applicant that bid the lowest price is awarded the contract.[19]

The findings described in this section generates a number of testable predictions regarding the design of competitive tenders in the aid context:

Prediction 1 *In tenders that allocate the procurement contract to the lowest bidder (price-only competition), there is a negative correlation between the number of competitors (in particular the number of non-profits) and the number of conditions in the TOR description that must be satisfied by the winner.*

What is not specified in the TOR is left to the discretion of the agent. So moving the project mission closer to the agent's ideal mission translates into imposing fewer conditions in the TOR description. Thus, Proposition 4 suggests that under the optimal price-auction an increase in the expected number of competitors, by increasing the expected intrinsic benefit of developing project of the second lowest bidder, makes it optimal for the principal to impose fewer conditions on the project's design. By taking into account the further distinction between non-profits and for-profits, an expected increase in the relative participation of the former should also lead to an increase in the expected intrinsic benefit of the second lowest bidder. So Prediction 1 follows.

[17] Indeed, the rental and hire of products or the procurement of a building project are less likely to involve strong mission preferences compared to the provision of social services, such as educational, health, or research projects.

[18] EuropeAid defines supply contracts those contracts that cover purchase, leasing, rental or hire of products. Work contracts cover the procurement of building or civil engineering projects.

[19] For more details see the Practical guide to contract procedures for European Union external actions.

Prediction 2 *The number of conditions listed in the TOR that must be satisfied by the winner is on average higher in those procurement contracts that are allocated through a scoring auction rather than through a price-only auction.*

This prediction follows from Proposition 5, which suggests that on average the project mission is closer to the agent's ideal mission in price-only competitions rather than in competitions based on both price and mission.

2.5. Optimal Contract with Budget Constraints

I now study the same optimal contracting problem, but in the presence of budget constraints. In this setting, the principal's payment represents the budget available to the agent to develop the project, and the agent's effort must now be interpreted as the agent's ex-post monetary investment in the project. There are, indeed, many natural situations in which a principal allocates a budget to an agent with expertise, who should then invest it in the public project. As contracts are incomplete, the amount of the budget that the agent will actually invest - rather than keep for personal consumption or waste - depends on the agent's intrinsic motivation and on the alignment between the project mission and his ideal mission. This extension is meant to capture, in particular, the contracting of public projects that are highly capital intensive, and where the agent has the expertise to make the investment but is not expected to financially contribute to the project. This is the case, for instance, in scientific and medical research projects or when the agent is an NGO with no access to independent resources.

Given the complexity of the analysis, I now assume that the principal faces only one agent of type $\theta \sim F(\theta)$. Furthermore, in order to keep the notation consistent with the rest of the paper, the model is still written and explained in terms of "effort" rather than "investment". But the latter interpretation remains the most appropriate.

Adding a budget constraint to the model has implications on the amount of effort that the agent can put into the project. This means that the agent cannot exert a level of effort whose cost is not covered by the principal's payment. Formally, this implies that

$$e^*(m,p,\theta) = \min\left\{\theta G(m_A - m), \sqrt{2p}\right\}$$

The agent exerts the minimum between his optimal unconstrained level of effort - the one he would choose if he were not budget constrained - and the level of effort he can afford given the amount of funding received from the principal.

Before turning to the problem under asymmetric information, it is worth mentioning that if θ were observable by the principal, the optimal contract would imply an ideological compromise of the agent that is *increasing* in θ and a payment that is just enough to cover for the optimal unconstrained level of effort of the agent, i.e. $p^*(\theta) = \theta^2 G(m_A - m(\theta))^2/2$. Indeed, contrary to Proposition 1, the principal can no longer save on payments by decreasing the agent's ideological compromise. As the project mission gets closer to the agent's ideal mission, the agent's effort increases, but so does the payment due by the principal. Thus, the negative relationship between payment and effort breaks down. The cost of effort is now entirely borne by the principal. It follows that the level of effort that maximizes the principal's utility is an internal solution: the higher is the weight that the principal attributes to output, θ_D, the higher is the level of effort that maximizes his utility. The higher is θ, the smaller is the ideological compromise that the principal needs to make to induce the agent to reach that level of effort.[20]

Under asymmetric information about θ, the maximization problem faced by the principal becomes

$$\max_{m(.),p(.)} E_\theta\Big(\theta_D G(m(\theta) - m_D)e - p(\theta)\Big) \tag{22}$$

subject to

$$\theta \in \arg\max_{\hat{\theta}\in\Theta} U(\hat{\theta}, \theta) = p(\hat{\theta}) + \theta G(m_A - m(\hat{\theta}))e^* - \tfrac{1}{2}e^{*2} \tag{23}$$

$$U(\theta) \geq 0 \tag{24}$$

$$e^* = \min\{\theta G(m_A - m(\theta)), \sqrt{2p(\theta)}\} \tag{25}$$

First, notice that in this new setting the participation constraint in (24) is always satisfied because the principal cannot lower the payment to extract the agent's intrinsic utility from exerting effort. Thus, it can be omitted from the analysis. Second, with this new effort function, the utility functions are no longer separable in payment and the single crossing differences condition does not automatically hold. Therefore, the problem requires complicated mathematical analysis. For example, when looking at deviations, one should take into account that the agent could be in a different state compared to the case in which he reports his true type: the budget constraint might not be binding if the agent reports his type truthfully, but it may be binding if he reports a different type, and vice versa. Furthermore, the fact that a type is budget constrained under a specific contract does not imply that also other types will be budget constrained under that same contract.

The solution to the optimization problem is based on several Lemmas. Below, I provide an outline of the overall proof by summarizing shortly the main logical steps. I restrict my attention to contracts in which $m(\theta)$ is continuous.

First, I show that there does not exist an implementable mechanism where more than one type exerts his optimal unconstrained level of effort and for which the budget constraint binds,[21] i.e. $p(\theta) = \theta^2 G(m_A - m(\theta))^2/2$. I call the type for which this holds $\overline{\theta}$. Since type $\theta = 0$ is never budget constrained, this leaves me with two possible cases: (1) $\overline{\theta} = 1$, i.e. no agent is budget constrained; (2) $\overline{\theta} \in (0, 1)$, i.e. types in $[0, \overline{\theta}]$ exert their optimal unconstrained level of effort, while types in $[\overline{\theta}, 1]$ are budget constrained.[22] Second, I show that in any interval of types that are not budget constrained, the strict single crossing differences condition holds. Therefore, in such intervals, $m_A - m^*(\theta)$ must be non-increasing in θ. This applies to the full interval of types when $\overline{\theta} = 1$, and in the interval $[0, \overline{\theta}]$ when $\overline{\theta} \in (0, 1)$. Third, I show that there always exists a pooling contract that gives the principal a higher utility than any (full or partial) separating

[20] This relies on the assumption that $\theta_D G(0) > \theta G(m_A - m_D)$. That is, if $m = m_D$, the agent under-invests in effort with respect to the level that maximizes the principal's utility. If this was not the case, the principal could set his own preferred mission and pay the agent just enough to allow him to exert the amount of effort that maximizes his utility.

[21] This also shows that the full information optimum with budget constraints is not implementable.

[22] It is indeed straightforward to show that under the optimal mechanism all types cannot be budget constrained. For more details see case $\overline{\theta} \to 0$ in the Appendix.

contract with decreasing $m_A - m^*(\theta)$. This holds for both $\overline{\theta} = 1$ and $\overline{\theta} \in (0, 1)$. Finally, I show that there exists no implementable mechanism in which $m_A - m^*(\theta)$ is increasing in θ in the interval of types that are budget constrained. That is, I rule out that $m_A - m^*(\theta)$ might be U-shaped when $\overline{\theta} \in (0, 1)$. This proves that the optimal mechanism must be a pooling contract. Proposition 6 follows:

Proposition 6 *The optimal mechanism is a pooling contract where (1) an agent with intrinsic motivation lower than $\overline{\theta}$ receives a financial rent and exerts his optimal unconstrained level of effort; (2) an agent with intrinsic motivation higher than $\overline{\theta}$ is budget constrained and receives no financial rents; (3) $\overline{\theta} > 0$.*

Proof. See Appendix.

In the presence of budget constraints, it is not optimal for the principal to screen the agent by offering a menu of contracts with different payments and project's missions. The intuition for this result is as follows: in the agent's utility function, the weight assigned to the project mission relatively to the financial payment is increasing in the agent's intrinsic motivation. Therefore, in order to screen the agent, the principal should offer to compensate higher types with a lower ideological compromise and lower types with a higher financial payment. However, the extent to which higher types can derive an intrinsic benefit from a project mission being close to their ideal mission depends on the amount of effort they are able to exert. Because of the budget constraints, the latter is bound to the payment. More specifically, the payment made by the principal acts as an upper bound for the level of effort that the agent can exert. This implies that the ideological and the financial compensation are complements rather than substitutes. For instance, a contract that specifies a low payment and a mission equal to the agent's ideal mission will still yield a low utility to a high type because the amount of effort that the latter can put into the project remains low. It follows that a separating equilibrium, to be implementable, requires low types to receive very high financial rents. As shown in the Appendix, this turns out not to be optimal for the principal. Proposition 6 suggests, moreover, that under the optimal pooling contract at least some agents with higher intrinsic motivations will always be budget constrained. This is to avoid the financial rent of the low motivated agents to be too high.

To see that the optimal mechanism would exhibit some pooling even in the presence of multiple agents, consider the participation and the incentive compatibility constraints of the lowest type, $\theta_i = 0$. While in the benchmark model the participation constraint of the lowest type can be set to bind, leading to an incentive compatible probability of winning the contract equal to zero, in the presence of budget constraints the lowest type always derives some positive utility from winning the contract. This holds because, as explained above, the participation constraint in (24) slacks by definition, i.e. payments must be strictly positive. It follows that under any implementable mechanism, the lowest type must have a strictly positive probability of winning the contract. If this was not the case, the latter would be better off by imitating a higher type in order to receive a positive payment with a non-zero probability.

While a formal solution is derived for one agent only, this result still provides some intuition for why, calls for research grants may not take the exact form of scoring auctions with predefined scoring rules, but exhibit some characteristics similar to pooling contracts where the amount of funding that is awarded does not result endogenously from a bidding process but is, to a large extent, fixed ex-ante.

2.6. Conclusion and discussion

The paper makes several contributions. First, the paper contributes to the theoretical literature on optimal contracting with motivated agents by analyzing, for the first time, a mechanism design problem where the agents vary in their unobservable intrinsic motivation levels and are incentivized not by outcome-contingent rewards, but by the choice of the project mission. Contrary to previous studies, the agents' intrinsic benefit from developing a project is partly endogenous and dependent on the project mission.

Second, the paper contributes to the theoretical literature on delegation by identifying a new channel that can affect the delegation of a relevant decision from a principal to an agent. More precisely, in the model presented in this paper the principal's delegation of the choice of a project mission to an agent is lower than the socially optimal level because the principal cannot observe the agents' intrinsic motivation.

Third, the analysis provides policy recommendations to governments, international organizations and private foundations who pursue specific missions, on how to optimally design a competition for the allocation of a project. In particular, the analysis suggests that (1) in the absence of practical impediments, the project is best allocated through a scoring auction whose scoring rule assigns a higher weight to the mission dimension relatively to the procurer's true preference; (2) in price-only auctions, the higher is the expected number of applicants, the fewer conditions should be imposed in the project mission; (3) in the presence of budget constraints, less competitive mechanisms, e.g. posted grant with pre-determined amount of funding, direct negotiations or direct allocations to regular partners, may be more desirable than auction tenders to allocate the project.

More generally, the paper provides guidance to managers on how to optimally design compensation packages in situations where the workers care about the mission of their job and where outcome-contingent rewards are not available. More specifically, the analysis suggests that managers should offer a menu of contracts with different levels of discretion and payment. Agents with high intrinsic motivation will then self-select in those contracts that pay less but offer more discretion on how to solve their tasks or on how to implement their projects. Furthermore, in each of these contracts, the manager should offer a lower level of discretion than the one he would offer if he could observe the workers' intrinsic motivation. Finally, in the presence of budget constraints, the manager may want to offer the same contract to all workers.

Fourth, the paper contributes to the longstanding debate on the desirability of public-private partnerships for the delivery of social goods by providing insights on whose values are more likely to dictate the provision of these goods and under which circumstances. As discussed in Chau and Huysentruyt (2006), one may be worried that public values, such as laicism, might be undermined by delegating the provision of social services to, for instance, religious organizations. On the other hand, there is the concern that the state may interfere with non-profits' goals and values, as the dependence on public funds is likely to make the non-profits vulnerable to political pressures. This paper shows that non-profits' missions are more likely to be compromised in the presence of informational asymmetries about the intrinsic motivation of their workers, when contracts are allocated through scoring auctions, and when competition within a price-only auction is low.

The model can be extended further in several ways. First, this paper focuses on a mechanism design problem where the agents vary in how much they value the mission dimension compared to the financial dimension when contracting the development of a project. An alternative approach would be to vary, instead, the distance between the agents' ideal missions and the principal's ideal mission. It is indeed plausible to assume that the mission preferences of some agents may be more aligned with the principal's ideal mission than others. Second, the present analysis presumes that monetary incentives to induce agent's effort are not available or desirable, for reasons outside the model. Such assumption could be relaxed to investigate situations where the principal has two instruments to motivate effort provision: a monetary incentive scheme that appeals to the agents' extrinsic motivation and the choice of the project mission that appeals to the agents' intrinsic motivation. Finally, the model generates a series of new theoretical predictions regarding the design of competitive tenders for the provision of social goods that are worth testing empirically. Given the relevant endogeneity issues present in field data, experimental data could provide valuable complementary evidence. All these extensions are left for future work.

Chapter 3

Job Mission as a Substitute for Monetary Incentives: Experimental Evidence

The design of incentives in organizations has always been at the core of economists' research agendas, motivating a large body of the empirical and theoretical literature. To date, however, most of the economic studies have focused on the design of financial incentives, such as pay-for-performance contracts and bonus awards. While these incentives can be a powerful tool in firms where employees' primary goal is to earn money, they may become less effective—or even harmful (Benabou and Tirole, 2003)—in organizations where workers perform tasks that have positive externalities for society, e.g. in organizations involved in the provision of social goods and services. Workers in these organizations are often driven only partly by financial rewards, but also by the mission of their job, i.e., by the overall job design and characteristics and its impact on society. This raises the question of whether principals use the job mission as a substitute for monetary incentives in eliciting effort from motivated agents. This is the central question of this paper.

The answer to this question has implications for a wide set of labor market environments, for instance, for the design of contracts in organizations that are involved in the provision of social goods and services. Given that many of these organizations do not generate profit and, therefore, have limited financial resources at their disposal, non-monetary incentives can play a major role in motivating employees, while, at the same time, reducing the organization's financial expenses. If employees care about the mission of their projects, it may be desirable for an employer to increase the employees' discretion in designing their own projects even though their mission preferences may not be perfectly aligned. For example, employees of a non-profit organization in the field of education may be willing to exert the same level of effort for a lower wage in order to be able to choose the characteristics of the project on which they work: the educational curricula that should be taught, the teaching methods that should be used, the beneficiaries' targeting, and so on. Such "ideological" issues play an important role in the social and development sector (Besley and Ghatak, 1999, 2001).

More generally, this analysis has implication for the design of contracts in organizations where employees solve tasks that involve a certain level of creativity. Motivated journalists, researchers, architects, and computer engineers, can feel very strongly about the products they develop and may be willing to give up financial gains in order to decide which news to cover, which research topics to address, which phone applications to design. Do firms and organizations such as the New York Times, the World Bank and Apple, take advantage of this intrinsic motivation when designing their contracts? Google seems to understand how to make the most of its employees' intrinsic motivation and mission preferences:"... by allowing its engineers to spend 20% of their work week on projects that interest them, Google is able to tap into the many talents of its employees."[1]

I address the above question in a novel laboratory experiment in which the choice of the job mission is part of the compensation package that a principal can use to motivate an agent. A laboratory experiment is an appropriate method to address this issue for several reasons. First, it allows to perfectly control for self-selection of agents with unobservable characteristics. For example, while a negative wage differential between the public and the private sector may be consistent with public organizations substituting mission and job design for monetary compensations, it may also result from workers with higher abilities self-selecting in the private sector, or from different production functions across sectors. Second, as it will become clearer from the design description, since the mission preferences of the principals and of the agents are not perfectly observable, identification must be achieved by comparing the behavior of the same individuals in different contexts, namely, by a within-subject design. Third, the effort task must be monetary in order to compare the agents' effort choices with the exact predictions made by different theoretical models. Only laboratory data allow one to perfectly control for all these issues.

In my experiment, pairs of subjects form principal-agent contractual relationships for the development of a project. The principal offers the agent a contract, which consists of a mission and a piece rate, to carry out the project. The agent then chooses a monetary effort level that generates a profit to the principal and a social output. The social output is implemented as a donation to a charity, while the choice of the project mission is implemented as the choice of which charity receives the donation. More specifically, the principal can offer two types of contracts: an open contract, or a closed contract. If the *closed* contract is offered, the effort exerted by the agent generates a donation to the principal's preferred charity. If the *open* contract is offered, the effort exerted by the agent generates a donation to the agent's preferred charity.[2] The agent is paid according to the piece rate specified in the offered contract. After receiving the contract, the agent chooses his effort level, which determines payoffs and donations. Thus, the employer cannot contract directly on effort. He can, however, influence the agent's effort level through the choice of the piece rate and through the choice of which of the two types of contract to offer, namely, the mission.

Notice that the choice of the project mission is only relevant if it entails a trade-off for the principal, namely, if the principal and the agent prefer different charities. If this wasn't the case, the choice between the open and the closed contract would be trivial and the question of whether the choice of the project mission is treated as substitute to monetary incentives could not be addressed. Thus, to generate a pool of subjects who care about different charities, in

[1] http://www.forbes.com/sites/laurahe/2013/03/29/googles-secrets-of-innovation-empowering-its-employees

[2] It is worth pointing out that differently from Fehr et al. (2013) and Charness et al. (2012), neither contracts imply a proper delegation of decision from the principal to the agent. The decision is always made by the principal about whose preferred charity receives the donation. Thus, this paper is not about the intrinsic value of authority.

the recruitment process students were informed that they would earn slightly less than usual in experiments but that they would be given the opportunity to generate a substantial donation to their favorite charity, which had to be specified in advance.[3]

In order to identify how agents' intrinsic motivation and mission preferences affect the contracts offered by the principals, I need to compare contracts offered to motivated agents with the contracts that the principals would offer if the agents were not intrinsically motivated and, therefore, did not care about the project mission. For this purpose, the experiment consisted of two treatments. In the *main* treatment, the agents were allowed to choose any desired effort level for any given piece rate. The parameters of the payoff functions were chosen such that an agent who is intrinsically motivated and thus cares about the charity, would choose an effort level that is higher than the piece rate offered in the contract. In the *control* treatment, the agents were not allowed to choose more effort than the level that maximizes their monetary payoff. That is, they could not choose an effort level that is higher than the piece rate specified in the contract. In this treatment any effort premium from agents' intrinsic motivation was, therefore, ruled out. The agents had to behave *as if* they did not care about the charities.

By comparing the piece rates and the frequency of open contracts offered across the two treatments, I am able to test whether principals treat monetary incentives and the choice of the project mission as substitutes to elicit effort from motivated agents. If this is the case, one should observe agents in the main treatment being offered the open contract more often and being paid less than agents in the control treatment. That is, in the presence of an effort premium from agents' intrinsic motivation, principals should be more likely to let the agents work for their preferred charity and they should offer lower monetary incentives compared to situations where this effort premium is absent.

The main results are the following: (i) Agents were motivated to generate a donation under both contracts, but more so when the donation was made to their preferred charity. In other words, conditional on the piece rate, in the main treatment effort exerted under the open contract was higher than under the closed contract, and both these efforts were higher than the effort exerted under any contract in the control treatment. This result shows that the mission of a job matters for motivated workers: the higher the mission-matching, the higher the effort level. (ii) Given a type of contract, open or closed, the piece rates were lower in the main treatment than in the control treatment. Hence, principals took advantage of the agents' effort premium in the main treatment by offering lower monetary incentives. (iii) The open contract was offered more frequently in the main treatment than in the control treatment. Thus, if faced with motivated agents who can act on their motivation, principals were more willing to compromise on the job mission to save on monetary incentives.

These results are further supported when matching subjects' decisions in the experiment with their choices from an allocation game, which was run at the end of the experiment to measure the charity preferences at an individual level. More specifically, I find that the results apply mainly to those subjects who, according to their decisions in the allocation game, have a stronger preference for their chosen charity compared to other charities.

Viewed jointly, these findings provide evidence that principals treat the choice of the job

[3]This recruitment procedure has, of course, generated a selected pool of subjects. This selection is, however, necessary because the underlying theory is about employers and workers who care about the mission of the project. The design is meant to reflect the environment of mission-oriented organizations rather than purely profit-driven firms.

mission as a substitute for monetary incentives, in order to elicit effort from motivated agents. In the experiment, this resulted in the same *realized* level of effort across treatments but with different combinations of incentives. That is, in the main treatment, principals were able to replace monetary incentives with non-monetary incentives and still induce the same level of effort as in the control treatment.

I also find, however, that principals were heterogenous in their willingness to substitute monetary with non-monetary incentives. This heterogeneity was driven by fairness considerations. I find that the high number of principals who, in a postexperiment questionnaire, reported some fairness concerns about offering a lower wage to a motivated worker, sacrificed profits because they were reluctant to lower the piece rate below a fair threshold. Thus, these fairness concerns acted as a limited liability constraint, making the substitution between the mission and the piece rate imperfect.

The findings of this paper contribute not only to the design of incentives in organizations, but also to our understanding of job satisfaction and wage differentials across organizations and sectors. They may help explain, for instance, why firms such as Google may be able to pay lower wages than their main competitor without becoming any less attractive to talented employees.[4] They may also explain why workers in mission-oriented sectors, such as welfare and religious services, are paid the lowest wage, but report the highest job satisfaction, across all sectors Pischke (2011). The results of this paper suggest that this is likely not driven only by self-selection of happy workers into these industries, but also by specific non-monetary job attributes in these sectors which substitute for low income.

The paper relates to several strands of literature. First, it relates to contract theory models with motivated agents (Besley and Ghatak, 2005; Delfgaauw and Dur, 2007; Cassar, 2014b). In a setting where the job mission is exogenous, Besley and Ghatak (2005) show that it is optimal for a principal to offer lower monetary incentives if he is matched with an agent who shares his same mission preferences. Similarly, Delfgaauw and Dur (2007) shows that more motivated workers imply weaker monetary incentives. In a setting where the choice of a project mission is endogenous and where the principal and the agent have misaligned mission preferences, Cassar (2014b) shows that it is optimal for the principal to (partly) compromise on the choice of the mission in order to save on financial payments. Thus, overall, the findings of this paper provide experimental support for the predictions of these models. Second, the paper relates to previous experimental studies that show that the matching of the job mission with the workers' preferred mission increases effort (Carpenter and Gong, 2013; Gerhards, 2013; Fehrler and Kosfeld, 2013; Besley and Ghatak, 2013; Tonin and Vlassopoulos, 2014). These studies, however, only focus on the behavior of the agents, and do not address the main question of this paper.[5] Finally,

[4]Circumstantial evidence reported in the New York Times suggests that:"...Google pays less and its health insurance is not as good as Microsoft." Source: http://bits.blogs.nytimes.com/2007/06/28/google-v-microsoft-whats-the-better-workplace. Taking a more extreme example, these results provide also an explanation for the recent empirical evidence in Bahney et al. (2013), which shows that insurgent fighters by Al Qa'ida Iraq are paid less than their outside options, even when compared to unskilled labor, and receive an estimated negative risk premium.

[5]Gerhards (2013) also analyzes the principals' choice and finds that principals pay higher piece rates in contracts with the agents' preferred mission than in contracts with a random mission. However, given that in the design by Gerhards (2013) principals often share the same mission preference as the agents, this may simply be the result of the employers wanting to elicit more effort for their preferred mission than for a random mission. Finally, (Nyborg and Zhang, 2013; Nyborg, 2014) shows that firms with a reputation as socially responsible pay significantly lower wages. These studies, however, only report correlations and cannot make any causal

the paper points to a different "hidden cost of control" which, contrary to Falk and Kosfeld (2006) and Bartling et al. (2012, 2013), does not arise from the perception that the lack of discretion is a signal of the principal's distrust, but from the fact that motivated workers have direct preferences on how to solve their tasks, and these preferences are not always aligned with the ones of their employers.

The remainder of the paper is organized as follows. The next section introduces the theoretical framework and predictions. Section 3.2 describes the experimental design. Section 3.3 presents the results. Section 3.4 discuss some results in more details. Section 3.5 concludes.

3.1. Theoretical Framework

3.1.1. The model

The theoretical basis for my experimental design is a simple extension, which I describe below, of the model by Besley and Ghatak (2005) to an environment where the project's mission is endogenous and where the principal and the agent have different mission preferences.

An agent is matched with a principal who offers him a contract for the development of a social project. The contract specifies a wage per unit of effort w , henceforth piece rate, and a project's mission $m \in \{m_P, m_A\}$, where m_P is the preferred mission of the principal, m_A is the preferred mission of the agent, and $m_P \neq m_A$. The agent will then exert a level of effort, e, to develop the project. The utility of the principal from implementing the contract (w, m) is equal to

$$V(e; w, m) = \Pi(e, w) + \gamma_m D(e) \qquad m = m_A, m_P \tag{1}$$

$\Pi(e)$ is the profit generated by the project as a function of the agent's effort. This is composed of the monetary output minus the piece rate cost. γ_m is the principal's valuation for the social output of a project with mission m, and $D(e)$ is the social output generated by the project as a function of the agent's effort. It follows that $\gamma_{m_P} > \gamma_{m_A} \geq 0$, that is, the principal values more the social output of a project with his preferred mission than with the preferred mission of the agent. The principal chooses (w, m) that maximizes (1). Given the contract (w, m), the agent chooses the level of effort that maximizes the following utility:

$$U(w, m; e) = we + \alpha_m D(e) - C(e) \qquad m = m_A, m_P \tag{2}$$

where α_m is the agent's intrinsic motivation to develop a project with mission m and $C(e)$ is the cost of exerting effort, which is equal to $\frac{1}{2}e^2$. It follows that $\alpha_{m_A} > \alpha_{m_P} \geq 0$, that is, the agent's intrinsic motivation is higher when he works for his preferred mission than for the preferred mission of the principal. If the agent were not motivated, he would not care about the project mission, i.e. $\alpha_{m_A} = \alpha_{m_P} = 0$.[6]

argument.

[6]Notice that in principle γ_{m_A} and α_{m_P} could also be negative, that is, the principal and the agent could derive an intrinsic cost from the social output of a project with mission m_A and m_P respectively. This could be the case, for instance, if mission preferences reflect different political or religious views, as in Carpenter and Gong (2013). This would, however, have no fundamental implication for the theoretical predictions. Nevertheless, since the experiment involves charities rather than political parties, for an illustrative point of view it is easier to just assume these parameters to be positive.

3.1.2. Analysis and theoretical implications

For sake of notational clarity, let's define w_m as the piece rate paid to the agent if the project's mission m is chosen. Finally, to keep the analysis simple, $\Pi(.)$ and $D(.)$ can be assumed to be linear in effort:

$$\Pi(e, w) = (\pi - w)e \tag{3}$$

$$D(e) = de \tag{4}$$

The agent's optimal level of effort is then

$$e_m^* = w_m + \alpha_m d \qquad m = m_A, m_P \tag{5}$$

The agent's optimal level of effort is increasing in the offered piece rate, in the intrinsic motivation from working in a project with mission m, α_m, and in the effort's productivity in generating social output, d. Since $\alpha_{m_A} > \alpha_{m_P}$, motivated agents exert more effort, for any given piece rate, in contracts with their preferred mission. Furthermore, this level of effort is higher than the piece rate. If an agent is not motivated, his optimal level of effort is equal to the piece rate independently of the project mission. This leads to the following prediction:

Prediction 3 *The effort premium from agents' intrinsic motivation is higher when the agents work for their preferred mission than for the preferred mission of the principals.*

Given the optimal level of effort in (5), the optimal piece rate in a contract with mission m is equal to

$$w_m^* = \text{Max}\Big\{0 \;\; ; \;\; \tfrac{1}{2}[\pi + d(\gamma_m - \alpha_m)]\Big\} \qquad m = m_A, m_P \tag{6}$$

The optimal piece rate is increasing in the effort's productivity in generating profit, π and in the principal's valuation of the social output of a project with mission m, γ_m. This is the *preference channel*: everything else being equal, the more the principal cares about the social output of a project, the higher the effort level he wants to elicit from the agent, and in turn, the higher the piece rate he will offer in the contract. More importantly for this study, the optimal piece rate is decreasing in the agent's intrinsic motivation to work for a project with mission m, α_m. This is the *substitution channel*: everything else being equal, the higher the agent's intrinsic motivation, the more the principal can save on monetary incentives, i.e., the more he can lower the piece rate. The experiment is designed to identify this channel.

These two channels have three implications for contract design. First, since the preference channel is stronger under the contract with the principal's preferred mission ($\gamma_{m_P} > \gamma_{m_A}$) while the opposite holds true for the substitution channel ($\alpha_{m_A} > \alpha_{m_P}$), wages are higher in contracts with the principal's preferred mission, i.e. $w^*_{m_P} > w^*_{m_A}$. This leads to a negative correlation between financial incentives and the alignment of the project mission with the agent's mission preferences. Second, because of the substitution channel, motivated agents are offered lower wages compared to non-motivated agents. If $\alpha_{m_P} > 0$, this is true for both project missions. Third, this piece rate differential should be higher if the motivated agent works for his preferred mission, as the substitution channel is stronger in this case. In other words, the principal can take more advantage of the agent's intrinsic motivation by lowering the piece rate when the latter works for his preferred mission. This generates the following prediction(s):

Prediction 4 *i) Wages are higher in contracts with the principals' preferred mission; ii) Motivated agents are paid less than non-motivated agents; iii) The piece rate differential in ii is higher if motivated agents work for their preferred mission than for the preferred mission of the principals.*

By replacing the optimal piece rate in the optimal effort function of the agent, I can derive the optimal level of effort as a function of the exogenous parameters only:

$$e^*_m = \tfrac{1}{2}[\pi + d(\gamma_m + \alpha_m)] \qquad m = m_A, m_P \tag{7}$$

Equation (7) suggests that for any project mission, the unconditional level of effort is increasing in both the principal's valuation for social output and the agent's intrinsic motivation. Comparative statics depend on the specific values taken by γ_m and α_m. Since these parameters can take any value, I cannot predict whether the unconditional level of effort will be higher under the contract with the principal's preferred mission or under the contract with the agent's preferred mission. For sufficiently high α_{m_A}, however, it is clear that the level of effort will be higher under the contract with the agent's preferred mission. Since wages are lower under such contracts, this can result in a negative correlation between effort and monetary incentive in a cross-section of organizations.

Finally, I can derive the principal's utility from each of the two contracts to make predictions about the optimal choice of the project's mission. Equation (1) can be rewritten as

$$V(e^*; w^*, m) = (\pi - w^*_m)e^*_m + \gamma_m d e^*_m \qquad m = m_A, m_P$$

Replacing the optimal level of effort and the optimal piece rate gives

$$V(m) = \frac{1}{4}[\pi + d(\gamma_m + \alpha_m)]^2 \qquad m = m_A, m_P \tag{8}$$

As for the unconditional level of effort, the principal's utility from the contract with project's mission m is increasing in both the principal's valuation for social output and the agent's intrinsic motivation for mission m. Which project's mission maximizes the principal's utility depends on the specific value taken by γ_m and α_m, $\forall\ m = m_A, m_P$. Notice, however, that the higher is the difference between α_{m_A} and α_{m_P}, that is, the stronger the agent feels about his preferred mission, the more likely is $V(m_A)$ to be higher than $V(m_D)$ and, therefore, the more likely should be the principal to let the agent work for his preferred mission. Now, in the extreme case where $\alpha_{m_A} = \alpha_{m_P}$, i.e. the agent is indifferent about the missions or the agent is not-motivated, the principal is undoubtedly better off by choosing his preferred mission, i.e. $m^* = m_P$. Indeed, if the principal cannot take advantage of the substitution channel, there is no reason why the principal should make a compromise on the mission. Therefore, compared to a situation where the agent is not intrinsically motivated, if the agent is motivated the principal should be more likely to offer the contract with the agent's preferred mission.[7] The last prediction follows:

Prediction 5 *Principals should be more likely to compromise on the mission the more the agents are motivated.*

Thus, all together, these predictions 4-5 imply that motivated agents should be compensated with higher non-monetary incentives and lower monetary incentives than non-motivated agents.

[7] In a setting where m is continuous, the model would predict that the higher the agent's intrinsic motivation, the larger the compromise that the principal would make on the project mission (Cassar, 2014b).

3.2. The Experiment

The design of the experiment closely follows the theoretical framework described in Section 3.1. The social output generated by the project is implemented as a donation to a charity that subjects can generate in addition to their monetary payoffs. The choice of the project's mission is implemented as the choice of which charity receives the donation. My identification strategy of the causal effect of the agents' intrinsic motivation on the choice of the piece rate and of the project mission is the comparison between the contracts offered to motivated agents and the contracts offered if the agents were constrained to behave as if they were not motivated. To do so, I run the two treatments described in Section 3.2.3.

3.2.1. Recruitment

The implementation described above only works if subjects care about different charities. If this were not the case, the choice of the project mission, i.e. the choice of which charity receives the donation, would not entail any trade-off for the principal. Thus, the question whether the choice of the project mission is treated as substitute to monetary incentives could not be addressed. To generate such pool of subjects, in the recruitment process students were informed that they may earn slightly less than usual in experiments but that they would be given the opportunity to generate a substantial donation to their favorite charity. Furthermore, in order to sign up, subjects had to specify the name and the website of their favorite charity. This recruitment procedure turned out to be successful as 92 different charities were chosen by 146 subjects. As soon as the subjects arrived in the laboratory, they received a list of all the charities that were chosen by subjects participating in the same experimental session. The list also specified the number of subjects choosing the same charity. Therefore, subjects knew the full distribution of charities choices.

In order to have updated information about subjects' charity preferences, at the beginning of the experiment subjects were asked to choose (again) their preferred charity from the list. Subjects' specific charity preferences were, however, kept confidential throughout the experiment. In other words, subjects knew that all the preferred charities of other subjects must be in the list but, when interacting with another subject, they did not know which specific charity in the list that other subject had chosen. As it will become clearer in the next section, this design choice had several advantages, including avoiding the risk, ex-ante, of matching subjects with preferences for the same charity.

3.2.2. Experimental design

After the instructions were read aloud, half of the subjects were assigned to the role of principals, the other half the role of agents. The same role was kept throughout the experiment, which consisted of multiple periods. At the beginning of each period, every agent was randomly and anonymously re-matched to a principal.

In each period, the sequence of actions was as follows. The principal chose a piece rate w in the integer set $\{1, 2, .., 9\}$, and whether to offer a closed or an open contract. If the closed contract was offered, the effort exerted by the agent generated, in addition to the principal's profit, a donation to the principal's preferred charity. If the open contract was offered, the effort exerted by the agent generated, in addition to the principal's profit, a donation to the agent's preferred charity. Thus, in terms of the model described in Section 3.1, the closed contract corresponds to the choice of a project mission equal to m_P, while the open contract corresponds to the choice of a project mission equal m_A.

The agent then chose a costly level of effort e in the integer set $\{1, 2, .., 9\}$ which determined payoffs and donations in that period. To rule out binding budget constraints, at the beginning of each period every agent was endowed with 35 points. This allowed the agent to exert the maximum level of effort even if the principal chose a piece rate of 1. Both the principal's profit and the level of donation depended linearly on effort as in (3) and (4). Specifically, $\pi = 10$ and $d = 20$. This choice of parameters, along with the convex effort function, ensured that it was not convenient neither for the principal nor for the agent to maximize own income and donate later. Finally, at the beginning of each period a base income of 20 points was given to every principal in order to get roughly the same monetary payoffs under the optimal choices for agents and principals who did not care about charities, i.e. for $e = w = 5$ in both contracts.

As subjects may vary in the extent to which they care about the charities and this is not observable, the strategy method was necessary to elicit the principal's choice of piece rate and the agent's choice of effort for both the closed and open contract. More specifically, I elicited the agent's effort choice for each possible piece rate in each contract. To elicit the principal's beliefs about the agent's effort, the principal also specified an expected level of effort for each of the two contracts given the chosen piece rate. This elicitation was, however, not incentivized and the expected effort level was not revealed to the agent. The principal would then choose which contract, between the open and the closed, to offer to the agent. The chosen contract was implemented with 75% probability, whereas with 25% probability the other contract was implemented. This random implementation of contracts was necessary to make the choice of piece rate incentive compatible even in the principal's least preferred contract. Furthermore, the fact that agents did not know with certainty whether the implemented contract corresponded to the contract chosen by the principal, and that the agents' effort in each contract was elicited ex-ante through the strategy method, make it very unlikely that the agents reciprocated principals who chose to offer the open contract.[8] At the end of each period, payoffs realized and became observable to the principal and the agent. To improve learning, the principal observed not only the level of effort and the donation realized, but also the level of effort chosen by the agent in the contract that was not implemented. Similarly, at the end of each period, the agent observed not only the piece rate offered in the implemented contract, but also the piece rate offered in the remaining contract. He also observed which of the two contracts the principal had chosen to offer. Principals and agents were then randomly re-matched.

As pointed out earlier, neither the principals nor the agents were revealed the preferred charity of the subjects they were matched with. It follows that the principal's choice between the closed and the open contract was equivalent to a choice between a contract that generated a donation to his preferred mission with certainty and a contract that generates a donation to any of the charity specified in the list with some probability.[9] Similarly, an agent knew that

[8]Reciprocity towards the choice of the open contract would have, indeed, the same implications as an increase in α_{m_A}, so it could have acted as a potential confound. On the contrary, note that reciprocity towards high wages, by reducing the principal's benefit from saving on monetary incentives, works against my hypothesis. Similarly, reciprocity only towards high wages in the open contract leads to the opposite prediction regarding the optimal choice of wages, namely, the principal may want to set higher wages in the open contract than in the closed contract.

[9]This probability was known to the subjects because, as mentioned above, they knew the full distribution of

his effort level in the closed contract would generate a donation to any charity specified in the list with a given probability, whereas his effort level in the open contract would generate a donation to his preferred charity with certainty. Thus, everything else being equal, it is clear that the principal's valuation of social output was higher under the closed contract while the agent's motivation was higher under the open contract. Theoretical predictions were, therefore, unchanged.

While this design feature did not affect the theoretical predictions, it had two main advantages. First, this design avoided the risk, ex-ante, of having too many pairs of principal-agent preferring the same charity. Second, it eliminated any heterogeneity across periods and treatments in the agent's intrinsic motivation under the closed contract and in the principal's valuation of output in the open contract. In terms of the model, this was equivalent to keeping α_{m_P} and γ_{m_A} of each individual constant across periods and treatments. Indeed, such unobservable heterogeneity across periods and treatments could have added substantial noise to the data and acted as a potential confound.

3.2.3. Treatments

The experiment involved two treatments. Each subject participated in both treatments. In the *main* treatment the agent was free to choose any desired level of effort. As shown in equation (5), if the agent cared about the charity he would choose an effort level that is higher than the piece rate offered in the contract. In the *control* treatment, the agent was not allowed to exert more effort than the level that maximized his material payoff. That is, the level of effort could not be higher than the piece rate specified in the contract. In this treatment any effort premium from agents' intrinsic motivation was, therefore, ruled out.

To keep the notation consistent with the theory described in Section 3.1, let w_{m_A} and e_{m_A} be, respectively, the piece rate and the effort level chosen in the open contract, while let w_{m_P} and e_{m_P} be, respectively, the piece rate and the effort level chosen in the closed contract. Treatment variations are summarized in Table 3.1.

Table 3.1: Treatment variation

Treatment	Effort
Main	$e_{m_A} \in \{1, 2.., 9\}$; $e_{m_P} \in \{1, 2.., 9\}$
Control	$e_{m_A} \leq w_{m_A}$; $e_{m_P} \leq w_{m_P}$

To ensure that both the principals and the agents understood the payoff implications of their choices, a payoff table was given in the instructions where, in red, was the effort choice that maximizes the agent's income for any given piece rate - thus, the table diagonal was in red - and, in blue, was the effort choice that maximizes the donation for any given piece rate, i.e. an effort level of 9 for any given piece rate. Thus, based on this payoff table, it was clear to both the principals and the agents that if the latter cared about the charity, in the main treatment they would choose a higher effort level than the piece rate.

charity choices.

Six sessions were run in total. To control for potential order effects, the order in which the two treatments were played were systematically modified across sessions. Each treatment lasted 10 periods. So overall, every subject made decisions for 20 periods. Payments to subjects and donations to charities were made according to the outcome of one out of the 20 periods selected at random.

3.2.4. Elicitation of preferences over charities

It is important to point out that subjects are likely to have heterogenous preferences over the charities. In terms of the model, this means that the agent's parameters α_{m_A} and α_{m_P} and the principal's parameters γ_{m_P} and γ_{m_A} are individual specific. Therefore, to add control and run robustness checks, it is useful to get an independent measure of these parameters at an individual level.

For this purpose, I use an allocation game with concave allocation function. At the end of the experiment, but before the subjects knew which period had been randomly selected to count for payments and donations, subjects were asked to allocate 40 points between themselves, their preferred charity, and a charity selected at random from the list. At the time of making the decision, however, subjects did not know which charity would be randomly selected from the list. So their information was analogous to the information they had when making decisions during the experiment. Let's define p_{ij} as the number of points allocated by subject i to a particular recipient j. To induce non-linearity and avoid corner solutions, we apply the following non-linear transformation to the payoff of recipient j: $P_{ij} = 7 * \sqrt{p_i j}$. That is, recipient j receives a payoff of P_{ij} points if subject i allocates p_{ij} points to him/her. Since every subject must allocate all 40 points, it follows that $\sum_j p_{ij} = 40 \ \forall i$.

According to this allocation function, any subject who cares about his preferred charity, i.e. any agent with $\alpha_{m_A} > 0$ or any principal with $\gamma_{m_P} > 0$, should allocate some points to his/her preferred charity. The optimal number of points allocated to the preferred charity is increasing in α_{m_A}, or equivalently in γ_{m_P}. Similarly, any subject who cares about the charities in the list as a whole, i.e. any agent with $\alpha_{m_P} > 0$ or any principal with $\gamma_{m_A} > 0$, should allocate some points to the random charity. The optimal number of points allocated to the random charity is increasing in α_{m_P} for the agents, or equivalently in γ_{m_A} for the principals.

The advantage of using an allocation game with concave allocation function is that it rules out potential corner solutions that may arise from efficiency concerns. So this method generates an approximate measure at an individual level of (i) the intensity with which subjects care about their preferred charities, i.e. of the size of α_{m_A} and γ_{m_P}; (ii) the importance of subjects' preferred mission compared to other missions, i.e. $\alpha_{m_A} - \alpha_{m_P}$ and $\gamma_{m_P} - \gamma_{m_A}$. The latter measures to what extent a principal, or an agent, is *mission-driven* and is particularly relevant for comparative statics across types of contract.

3.2.5. Questionnaire on fairness

Finally, at the end of the experiment subjects answered a very short questionnaire. The purpose of the questionnaire was to elicit subjects' fairness perceptions about the substitutability between monetary and non-monetary compensations. Previous survey evidence by Kahneman et al. (1986) reveals, indeed, that fairness considerations may affect wage-setting decisions.

More specifically, subjects were asked the following two questions: i) "Suppose you run an organization with two employees: employee A and employee B. These employees are assigned the exact same task. Furthermore, they are identical in every aspect: in particular, they have the same ability and are equally productive. There is only one difference: employee A enjoys the task more than employee B does. Would you pay them the same wage?" Subjects could choose between three options: "same wage", a "higher wage to employee A", and a "higher wage to employee B"; ii) "Suppose you run an organization and you are in the process of hiring a new employee. During the job interview, you realize that the candidate for the position would really enjoy the job so he/she would accept to do the same amount of work even for a lower wage than the one you initially planned to offer. Would you offer the candidate a lower wage than the one you initially planned?" After having answered this question, subjects were asked whether they thought it was fair to offer a lower wage.

3.2.6. Procedural details

Overall 146 subjects participated in six sessions, 73 in the role of principals and 73 in the role of agents. The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007a). Our subject pool consisted primarily of students at the University of Zurich and at the Federal Institute of Technology in Zurich and were recruited using the software hroot (Bock et al., 2012a). Subjects were paid based on the number of points generated in one period selected at random from the experiment and based on the number of points they allocated to themselves in the allocation game. Donations to charities were also made accordingly. In addition, each subject received a show-up fee of 10 SFr. On average, an experimental session lasted 1 hour and 45 minutes. The average payment was 35 SFr and the average donation was 36 SFr per pair of subjects.

3.2.7. Hypotheses

The analysis of the theoretical model in Section 3.1 generates a set of predictions that I now restate as hypotheses to be tested in the experiment.

First, the model predicts that conditional on piece rate, the effort premium from agents' intrinsic motivation is higher in contracts with the agents' preferred mission. Prediction 3 translates to the following hypothesis:

Hypothesis 1 *In the main treatment, conditional on piece rate, effort is higher in the open contract than in the closed contract. Furthermore, effort in the main treatment should be higher than in the control treatment.*

This first hypothesis tests if the project mission is effective in motivating effort provision. Notice that this hypothesis needs to be satisfied in order to test the remaining hypotheses.

Next, conditional on the hypothesis above being satisfied, the model makes predictions about the level of piece rate offered by principals. Specifically, it predicts that wages are higher in contracts with the principals' preferred mission. Indeed, in such contracts, there is (i) a *stronger* preference channel: the principal wants to elicit a higher donation for his preferred charity than for any other charity; (ii) a *weaker* substitution channel: the agent needs higher monetary incentives to provide effort for the principals' preferred charity than for his own preferred charity. Prediction 4a translates to the following hypothesis:

Hypothesis 2 *Wages are higher in the closed contract than in the open contract.*

This second hypothesis tests if, contrary to the results in Gerhards (2013), there is a negative correlation between financial incentives and the alignment of the project mission with the agents' mission preferences. Testing this hypothesis alone, however, can not answer whether principals take advantage of the agents' intrinsic motivation by saving on monetary incentives. To address this question, I need to disentangle the substitution channel from the preference channel. My identification strategy is to compare the piece rate offered by principals within a specific type of contract across the two treatments. By comparing wages within the same type of contract, the preference channel is constant, and therefore, any observed piece rate differential across treatments must come from the substitution channel: while the substitution channel should be active in the main treatment, in the control treatment, since the effort premium from intrinsic motivation is ruled out by design, the substitution channel is switched off. This is equivalent to Prediction 4b, which translates to the following hypothesis:

Hypothesis 3 *Conditional on the type of contract, wages are lower in the main treatment than in the control treatment.*

This hypothesis tests if, given a certain project mission, the principal takes advantage of the agent's intrinsic motivation to work for that mission by lowering the piece rate. In other words, this tests if the principal would pay a motivated agent a lower piece rate than a non-motivated agent.

The size of the substitution channel will depend, of course, on the size of the effort premium resulting from the agent's intrinsic motivation in Hypothesis 1. Since I expect the effort premium to be higher if the agent works for his preferred mission, the next hypothesis follows from Prediction 4.iii:

Hypothesis 4 *The piece rate differential across treatments is higher in the open contract than in the closed contract.*

Finally, the model makes predictions about the principal's choice of the project's mission. More specifically, if the agent is not motivated, the principal has no reason to choose a different mission from his preferred one. On the contrary, if the agent is motivated, the principal may want to compromise on the mission in order to save on monetary incentives. The next hypothesis follows from Prediction 5:

Hypothesis 5 *The principal is more likely to offer the open contract in the main treatment than in the control treatment.*

Hypotheses 3-5 together test if the principal treats the choice of the project mission as a substitute for monetary incentives in motivating effort provision.

3.3. Results

I start by describing the results from the allocation game to test whether the recruitment process was successful in generating the right pool of subjects. These results will also be used for robustness checks in the subsequent analyses. I then report the agents' effort choices. Indeed, in order to address the central question of this paper, it is necessary to find the predicted effort differences across contracts and treatments. Finally, I turn to the central part of this paper, namely, to the principals' choices of piece rates and contracts.

3.3.1. Descriptive statistics from the allocation game

The results from the allocation game are illustrated in Figure 3.1. Recall that the subjects had to allocate 40 points between themselves, their preferred charity, and one charity in the list selected at random. The figure shows the number of points allocated by subjects to their preferred charity and to the random charity in the list. By subtracting these numbers from the 40 points endowment, one can infer how many points subjects kept for themselves. Circles below (above) the 45-degree line indicate higher (lower) number of points allocated to one's preferred charity compared to the random charity. Circles below (above) the line $y = 20 - x$ indicate higher (lower) number of points allocated to oneself compared to both the charities. The size of the circles reflect the number of observations. The biggest circle represents 16 observations while the smallest circle represents one observation.

As can be seen, with the exception of one subject, all other subjects allocated equal or more points to their preferred charity than to the random charity in the list. Furthermore, only a minority of subjects, approximately 11 percent, acted as a pure profit maximizers by keeping all the money for themselves. Roughly a fifth of the subjects seemed to be indifferent between all charities in the list.

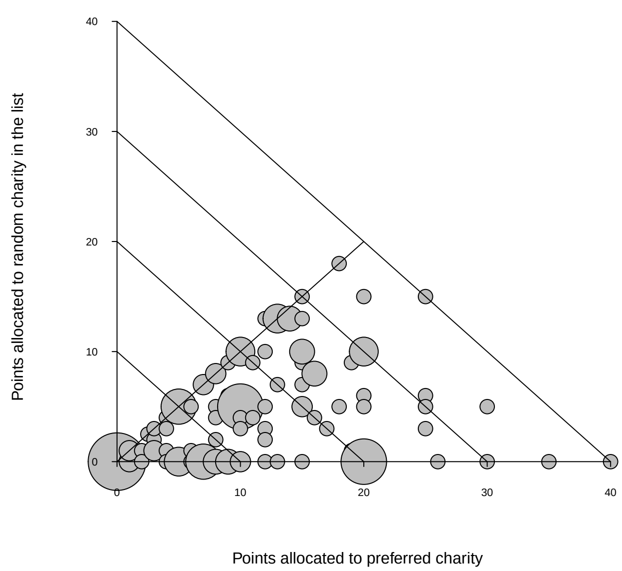

Figure 3.1: Allocation Choices

While this is only an approximation of subjects' preferences over charities, and taking into account that these preferences were elicited only at the end of experiment, it still provides some informative evidence that, overall: i) Subjects cared about the charities; ii) The charities were not perfect substitutes, but subjects strictly preferred their chosen charity. Thus, the recruitment process was successful in generating the right pool of subjects to address the questions of this paper.

3.3.2. Agents' effort choices

I start by analyzing the agents' effort choices for different wages and contracts in the two treatments. Consistent with Hypothesis 1, I find:

Result 1 *Within the main treatment, effort is higher in the open contract than in the closed contract. And for both types of contract, effort in the main treatment is higher than in the control treatment.*

Evidence for Result 1 can be seen in Figure 3.2. This figure shows the effort choices per piece rate and type of contract elicited through the strategy method in each treatment. The black line represents the 45 degrees line. Thus, any point on the right of the black line corresponds to a (positive) effort premium from intrinsic motivation.

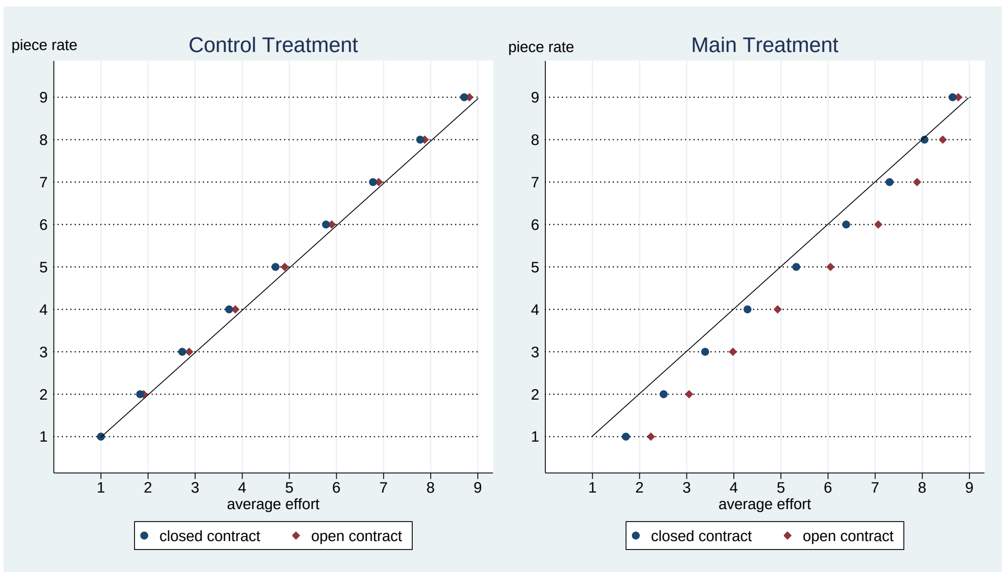

Figure 3.2: Effort Choices

As predicted, because of the imposed restriction on the agents' choice set, in the control treatment the average effort in both contracts is equal or slightly lower than the piece rate. On the contrary, in the main treatment average effort in both contracts is always higher than the piece rate - with the obvious exception for a piece rate equal to 9. Furthermore, within the main treatment, for any given piece rate average effort is roughly half unit higher in the open contract than in the closed contract. To assess the statistical significance of these effort differences, I use the one-sided clustered version of the signed-rank test proposed by Datta and Satten (2008), which controls for potential dependencies between observations. Within the main treatment, for each given piece rate, individual and period, I calculate the difference between the effort choice in the open contract and in the closed contract. This generates 10 observations per subject, per piece rate. Clustering at the individual level, I find that for any piece rate level, the effort choice in the open contract is significantly higher than in the closed contract ($p < 0.01$). Using the same test to assess the statistical significance of the effort differences across treatments, I find that for any piece rate level in a specific type of contract, the effort choice in the main treatment is significantly higher than the effort choice in the control treatment - and also higher than the piece rate ($p < 0.01$). This holds for both the open and the closed contract.[10]

Table 3.2: Regressions

	(1) effort	(2) piece rate	(3) open contract	(4) beliefs effort
piece rate	0.942***			0.686***
	(0.014)			(0.050)
piece rate*open	–0.014			–0.053
	(0.008)			(0.035)
open contract	0.179***	–0.755***		0.137
	(0.046)	(0.156)		(0.224)
main treatment	0.510***	–0.684***	0.116***	0.309***
	(0.109)	(0.131)	(0.029)	(0.091)
main*open	0.422***	0.056		0.703***
	(0.083)	(0.149)		(0.118)
constant	0.041	6.041***	0.298***	1.520***
	(0.088)	(0.152)	(0.042)	(0.299)
Round FE?	Yes	Yes	Yes	Yes
Session FE?	No	No	No	No
Individual FE?	Yes	Yes	Yes	Yes
Adj. R^2	0.878	0.125	0.024	0.468
Observations	26280	2920	1460	2920

Standard errors are clustered at the individual level. All regressions use a fixed-effect model. The dependent variables in regression (1), (2), (3), (4) are, respectively, the agent's effort level, the principal's belief about the agent's effort level, the piece rate offered by the principal, the type of contract chosen by the principal. More specifically, in regression (4), the dependent variable equals "1" if principals chooses the open contract and "0" if the principal chooses the closed. Significance levels: *** p<.01, ** p<.05, * p<.1.

Similar results are found in the OLS regression, which is reported in Table 3.2. It can been seen from regression (1) that conditional on piece rate, average effort is 0.51 unit points significantly higher in the main treatment than in the control treatment. Furthermore, as shown in the interaction of main treatment and open contract, this treatment difference is 0.42 unit points significantly higher in the open contract than in the closed contract. Thus, the overall effort premium from being matched with a motivated agent who works for his preferred mission is almost one additional unit of effort.[11] Results are robust to using a Tobit model, to clustering at the session level, or to restricting attention to the first period only, i.e., where potential spillover effects are fully ruled out.

[10]Figures A.1-A.9 in the Appendix also report, for any given piece rate, the time path of the effort level chosen in the open and in the closed contracts across treatments. It can be seen that Result 1 is robust throughout the time periods and wages - with the exception, of course, for the piece rate equal to 9 where there can't be any effort premium from intrinsic motivation.

[11]Note that if subjects in the control treatment were really non-motivated, the coefficient on the variable open contract should not be significant, as they would not care about any charity. So this is probably due to a minority of workers who disliked some charities in the list, and therefore, in the control treatment and closed contract they chose a level of effort lower than the piece rate. This has no implication for the interpretation of the results, because if anything, it should make it harder to find a treatment effect.

Figure 3.3: Average effort in the main treatment by different agents

Finally, Figure 3.3 uses data from the allocation game to distinguish between the effort levels chosen by agents with different charity preferences. As Hypothesis 1 relies on the assumption that agents care more about their chosen charity than about any other charity in the list, i.e. $\alpha_{m_A} > \alpha_{m_P}$, I distinguish between those agents whom I define as *mission driven*, i.e. those who, in the allocation game, allocated more points to their preferred charity than to the random charity, and those who are *not mission driven*, i.e. who allocated the same number of points, including 0, to their preferred charity and to the random charity. As can be seen, in the main treatment, for any given piece rate, the difference in effort levels between the open and the closed contract is approximately half a unit larger for agents who are mission-driven than for those who are not. For the latter, this difference almost disappears. Not surprisingly, the mission of a job is not an effective incentive tool if agents are not motivated or if they don't have specific mission preferences.

These results show that, overall, agents were motivated to generate a donation to a charity, but more so if the donation was directed to their preferred charity rather than to the preferred charity of the principal.

3.3.3. Principals' piece rate choices

I now analyze the piece rate offered by principals in different contracts and treatments. Consistent with Hypothesis 2, I find that:

Result 2 *Wages are higher in the closed contract than in the open contract.*

Evidence for Result 2 can be seen in Figure 3.4. This figure compares the average piece rate offered across treatments and contracts. It can be seen that in both treatments, the average piece rate in the closed contract is higher than in the open contract (signed-rank test with clusters $p < 0.01$). Notice, furthermore, that this piece rate differential should be higher for principals who are mission-driven ($\gamma_{m_P} > \gamma_{m_A}$) than for those who are not ($\gamma_{m_P} = \gamma_{m_A}$). Indeed, since the latter do not care about the charities, or are indifferent between them, the

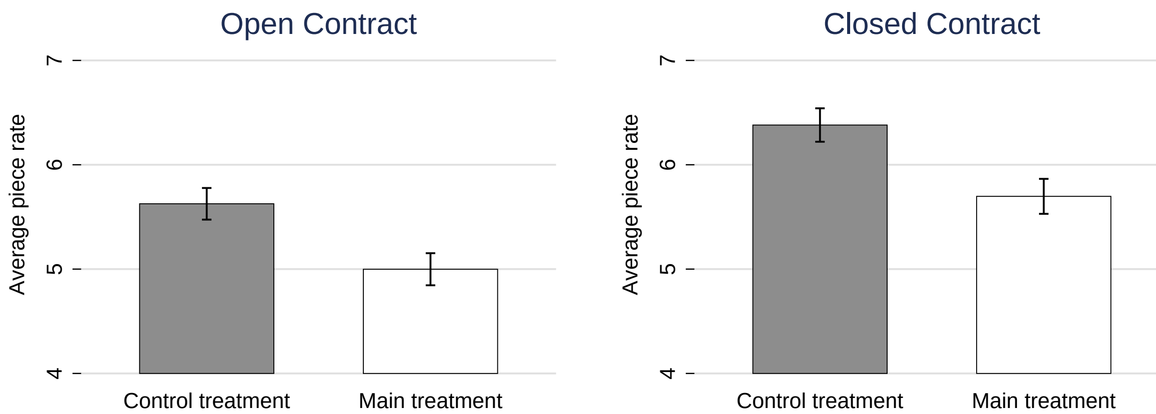

Figure 3.4: Piece rate choices

preference channel will not be higher in the closed contract. Consistent with this argument, Figure 3.5 shows that the piece rate differential between contracts is approximately 0.6 units higher for mission-driven principals than for principals who are not mission-driven (rank-sum test with clusters $p < 0.05$).

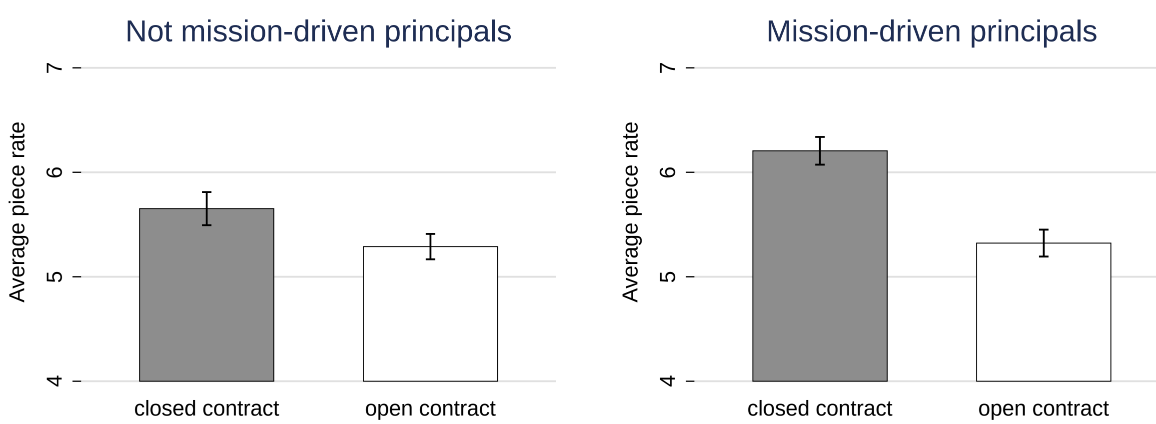

Figure 3.5: Piece rate choices by different principals

Figure 3.4 also reveals the first main result of this paper. Consistent with Hypothesis 3, I find:

Result 3 *For both types of contract, wages are lower in the main treatment than in the control treatment.*

It can be seen that in both the open and the closed contract, the average piece rate in the control treatment is approximately 0.7 unit points (or 14 percent) higher than in the main treatment. Both these differences are highly significant (signed-rank with clusters $p < 0.01$). Since the preference channel is constant within the same type of contract, these piece rate differentials between treatments identify the substitution channel. Thus, this result shows that principals take advantage of agents' intrinsic motivation by lowering the piece rate by approximately 14 percent.[12]

Another important observation to take from Figure 3.4, however, is that the piece rate differential between treatments is the same in both types of contract. This is confirmed by the signed-rank test with clusters. So in others words, in contrast with the theoretical predictions, the substitution channel is not higher in the open contract than in the closed contract. Hypothesis 4 is, therefore, rejected.

Result 4 *There is no difference in the piece rate differential between treatments across the two contracts.*

Similar results are found in regression (3) in Table 3.2. It can be seen that wages in the open contract are 0.76 unit point significantly lower than in the closed contract. Furthermore, wages in the main treatment are 0.68 unit point lower than in the control treatment. Both these differences are highly significant. The interaction between open contract and main treatment is, however, positive and insignificant. This confirms that the treatment effect is the same in both contracts. Explanations for this result are discussed in Section 3.4. Again, results are robust to using a Tobit model, to clustering at the session level, or to restricting attention to the first period only, where potential spillover effects are fully ruled out.[13]

3.3.4. Principals' contract choices

Next, I analyze the principals' contract choices across treatments. Consistent with Hypothesis 5, I find:

Result 5 *The open contract is more frequently offered in the main treatment than in the control treatment.*

Evidence for Result 5 can be see in the left of Figure 3.6. In the main treatment the open contract is offered approximately 40 percent of the time, whereas in the control treatment the

[12] One possible alternative interpretation of the result that wages in the open contract are higher in the main treatment than in control treatment could be that principals care about the agents and do not want to prevent them from generating a high donation to their favorite charity by setting a low piece rate in the control treatment. Indeed, recall that the piece rate offered by the principal acts as an upper-bound on the effort that the agent can exert and, thus, on the donation that can be generated. This interpretation, however, cannot explain the piece rate difference across treatments that is found in the closed contract, where the donation is directed to the principal's preferred charity. Furthermore, if one believes that in the allocation game, the number of points allocated by a principal to the preferred charity of a subject taken at random is correlated with how much a principal may care about other subjects - and thus about the agents-, I find that Result 8 does not change when I distinguish between principals who allocated some points to the random charity and those who did not. The results are available upon request.

[13] Figure A.10 in the Appendix also reports the time path of the piece rate offered in the open and in the closed contracts across treatments. It can be seen that throughout all time periods, for both types of contracts, wages are higher in the main treatment than in the control treatment. Furthermore, within each treatment, wages are higher in the closed contract than in the open contract.

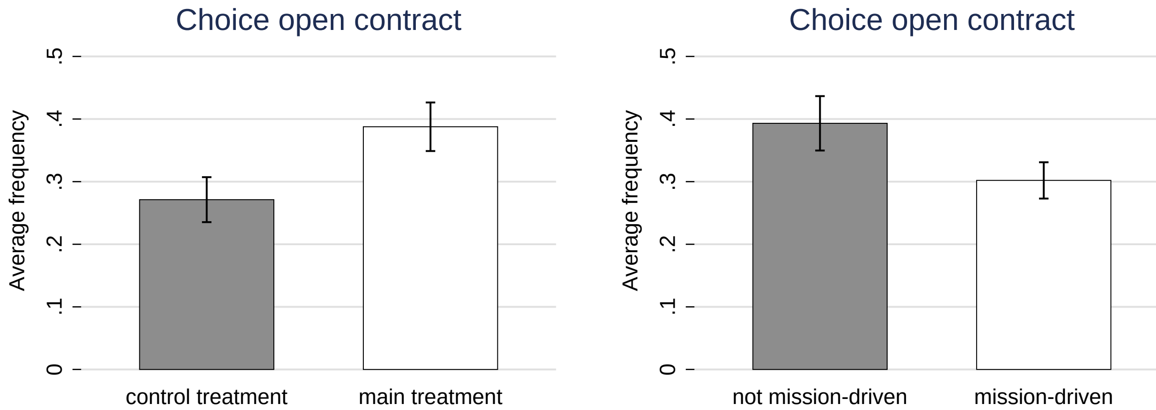

Figure 3.6: Contract choices by treatment and different principals

open contract is offered approximately 28 percent of the times.[14] This difference is highly significant (signed-rank test with clusters $p < 0.01$).

Additional evidence for Result 5 can be found in the regression (4) reported in Table 3.2. It can be seen that the probability of the open contract being offered is approximately 12 percent higher in the main treatment than in the control treatment ($p < 0.01$). The marginal effect from a Probit model gives the same result.[15]

Finally, notice that principals who are not mission-driven should be more likely to offer the open contract than principals who are mission-driven. Indeed, since the formers are indifferent between the charities, they don't make any mission compromise by letting the agents generate a donation to their preferred charity. The right side of Figure 3.6 shows exactly this. Open contracts are offered 10 percent more frequently by principals who are not mission-driven than by principals who are mission-driven. However, this difference is not significant (rank-sum test with clusters $p = 0.110$).

Results 8 and 5 together provide evidence that principals treat the choice of the project mission as substitute for monetary incentives. Motivated agents are more likely to work for their preferred missions and are paid less. This answers the central question of the paper.

3.3.5. Realized effort, piece rate and profit

I now turn my attention to the realized effort and piece rate choices. As it can be seen in Figure B.12, the average realized effort is approximately equal to 6 in both treatments. This means that, on average, the same amount of donation was generated across treatments. However,

[14] Notice that based on the predictions from standard contract theory models, the principal should never offer the open contract in the control treatment. Indeed, as any effort premium is ruled out by design, there is no reason to offer the open contract in the control treatment. Thus, this result is probably driven by some of social preferences of the principals towards the agents.

[15] Figure A.11 in the Appendix also reports the time path of the contract choice across treatments. It can be seen that, with the exception of the first period, the frequency of open contracts being offered is always higher in the main treatment than in the control treatment.

as it also appears in Figure B.12, the average realized piece rate is approximately 10 percent lower in the main treatment than in the control treatment. Thus, in the main treatment, principals were able to replace monetary incentives with non-monetary incentives, i.e., with letting the agents work for their preferred charities, and still induce the same level of effort as in the control treatment. As it can be seen in Figure B.13, these financial savings from agents' intrinsic motivation increases principals' average profit in the main treatment by approximately 10 percent compared to the control treatment. On the contrary, agents' average income is approximately 9 percent lower in the main treatment than in the control treatment.

3.4. Discussion

Result 4 contradicts the theoretical predictions from section 3.1. Surprisingly, the piece rate differential between treatments is not higher in the open contract than in the closed contract. However, given that the agents' intrinsic motivation is higher under the open contract, the amount that a principal can save in terms of piece rate from being matched with a motivated agent should be higher under the open contract than under the closed contract. Why is this not the case?

Based on Figure B.14 in the appendix and regression (4) in Table 3.2, this does not seem to depend on principals' erroneous beliefs about agents' intrinsic motivation, as the formers correctly anticipate a higher effort premium in the open contract than in the closed contract for any given piece rate. It can been seen from regression (4) that conditional on the piece rate, average expected effort is 0.3 unit points significantly higher in the main treatment than in the control treatment. Furthermore, as suggested by the coefficient of the interaction term, this treatment difference is 0.7 unit points significantly higher in the open contract than in the closed contract. So, consistent with the actual agents' effort choices, the overall expected effort premium from being matched with a motivated agent who work for his preferred mission is approximately one additional unit of effort. Hence, principals correctly anticipate that agents' are intrinsically motivated to generate a donation to a charity, particularly so in the open contract.

A potential explanation, consistent with the data, is that many principals may be sacrificing profits in the open contract because they are reluctant to offer a piece rate below what I call the *standard* piece rate, that is, the piece rate that a principal would offer if neither him nor the agent cared about the charities, namely, if $\gamma_m = \alpha_m = 0, \quad i \in \{A, D\}$. Given the parameters chosen in the experiment, this corresponds to a piece rate of 5. Notice, that based on equation (6), in the main treatment the piece rate offered by the principals in the open contract should be, on average, lower than the standard piece rate. Indeed, α_{m_A} should be, on average, higher that γ_{m_A}, and therefore, in the main treatment the average piece rate in the open contract should be lower than 5.[16] Importantly, as it is evident from equation (6), the same predictions do not hold for the closed contract. The reason is that in such contracts principals are more motivated than the agents to generate a donation, as the latter is made to their preferred charity. That is, γ_{m_P} should be, on average, higher that α_{m_P}.[17] Similarly, since in the control

[16]This is confirmed by the data from the allocation game. On average, agents allocate to their preferred charity more than twice (10 points) as much as the principals allocate to a random charity in the list (4.3 points).

[17]This also is confirmed by the data from the allocation game. On average, principals allocate to their

treatment the substitution channel is switched off, the piece rate should never be lower than 5 in neither type of contracts. Thus, if, as I hypothesize, such *fairness constraint* exists, it would only be binding for the open contract in the main treatment, but not in the closed contract nor in the control treatment.

Consistent with this argument, as shown in Figure 3.4, in the control treatment or in the closed contract, the average piece rate is significantly higher than 5, whereas in the open contract in the main treatment the average piece rate is just equal to 5. A similar picture emerges if we look at the distribution of wages chosen in different treatments and contracts (Figure B.15). While the frequency of wages below 5 in the open contract in the main treatment (30 percent) is significantly higher than in the closed contract (17 percent) or than in the control treatment (11 percent), it is still quite low compared to the theoretical predictions. I, therefore, conjecture that principals are reluctant to set a piece rate below the standard piece rate.

Taking this conjecture as given, the next question is why are the principals reluctant to set a piece rate below the standard piece rate. Inequity aversion as defined in Fehr and Schmidt (1999) does not seem to be the reason because, given the parameters chosen in the experiment, inequity averse principals would prefer wages that are equal or lower than the standard piece rate, but not higher. Neither is there evidence, from Figure 3.2 or Figure B.14, of negative reciprocity nor of expected negative reciprocity by principals with respect to wages below the standard piece rate in the open contract.[18]

Such reluctance seems related to a different fairness standard: offering a piece rate below the standard piece rate is a clear sign of exploiting workers' intrinsic motivation, and therefore, many principals who consider this to be unfair are more reluctant to lower the piece rate beyond that level. Subjects' responses to a survey conducted at the end of the experimental study are consistent with this argument. When asked if, in the role of employers during a job interview, they would offer a lower piece rate than the one they initially thought to offer if they realized that the job candidate would really enjoy doing this job, only 22 subjects replied they would offer a lower piece rate, while 124 subjects replied they would not offer a lower piece rate, most of them for fairness reasons.

By matching subjects' survey responses with the decisions made in the experiment, I get the following results. Regressions reported in Table B.1 show that in the main treatment those 14 percent of principals who do not perceive as unfair to offer a lower piece rate to the motivated job candidate are more likely in the open contract - but not in the closed contract- to offer a piece rate below the standard piece rate compared to the other principals ($p < 0.1$). This difference is equally significant using a clustered version of the rank-sum test proposed by Datta and Satten (2005). Furthermore, for this sub-sample of principals, Figures A.16 and A.17 show that: (i) In the main treatment, throughout all time periods, the average piece rate offered in the open contract is lower than the standard piece rate. (ii) In almost every period, the piece rate differential between treatments is higher in the open contract than in the closed contract.[19] Given the sub-sample small size, and given that the experiment was not designed to test this

preferred charity almost 3 times (11.7 points) as much as the agents allocate to a random charity in the list (4 points).

[18] Given a piece rate below the standard piece rate, only 8 percent of the observed effort levels are lower than the piece rate offered in the open contract.

[19] However, potentially due to the lack of power in such a small sample, I cannot establish statistical significance.

specific hypothesis, this interpretation should be, however, taken with caution.

So the overall picture that emerges from this analysis is that principals are heterogeneous in the extent to which they are willing to take advantage of agents' intrinsic motivation by saving on wages. Most principals seemed to be willing to take advantage of agents' intrinsic motivation as long as the offered piece rate was still higher or equal than the standard piece rate. Contrary to the theoretical predictions, only one third of the principals were willing to offer a motivated agent a piece rate below the standard piece rate in the open contract. These results provide experimental support for previous survey evidence by Kahneman et al. (1986), which suggests that fairness considerations can act as a constraint on the employers' profits. In this experiment, fairness considerations acted as a limited liability constraint. This constraint made the substitution between monetary and non-monetary incentives *imperfect*.

3.5. Concluding Remarks

Recently, much attention has been devoted to study how agents respond to different monetary and non-monetary incentives.[20]. There is no evidence, however, on how principals combine these incentives in order to induce effort. This paper reports the results from an experiment that was designed to test, for the first time, how principals write contracts when agents care about the mission of their job and when the principals have two instruments, the piece rate and the choice of the project mission, to influence the agents' effort. Therefore, this study also created a new paradigm that can be used for future laboratory experiments with motivated agents and misaligned mission preferences between principals and agents.

On the whole, my results provide evidence for the validity of the theoretical predictions from contract theory models with motivated agents (Besley and Ghatak, 2005; Delfgaauw and Dur, 2007; Cassar, 2014b). I show that principals take advantage of agents' intrinsic motivation by lowering the piece rate and use the choice of the project mission as a substitute to motivate effort. Because of fairness considerations, however, this substitution remains imperfect.

But, of course, some questions remain open. First, the experiment is designed to test the validity of such predictions in a fully "neutral" environment, namely, in the absence of additional features of labor relations that may play a role in a natural environment. In reality, the matching of employers and workers is not exogenous, but rather, workers and employers with similar mission preferences will try to match and form a long-term contractual relationship. This selection and long-term interaction may, of course, enhance the development of social ties between the employers and the workers and, in turn, increase the effect of fairness considerations relative to a one-shot game. Whether these stronger fairness considerations would translate into higher wages or into better alignments of the job mission with the workers' preferred mission remains, however, an open question.

Finally, while the experiment did not allow for any competitive forces, in a natural environment competition between workers plays a crucial role in the determination of wages. More specifically, competition is likely to act against fairness considerations and reinforce the substitutability between monetary and non-monetary incentives: why should a non-profit or-

[20]The latter include not only the job mission, but also status incentives and social recognition (Kosfeld and Neckermann, 2011; Ashraf et al., 2014), corporate social responsibility (Koppel and Regner, 2013), and the job impact (Kosfeld et al., 2014)

ganization hire a new employee if it can count on the effort of a motivated volunteer who is willing to work for free? These extensions are left for future work.

Chapter 4

A Matter of Perspective: How Fairness Views Depend on Relative Income

The redistribution of income has been and will presumably remain one of the most debated aspects of public policy in modern economies. Furthermore, many other economic policy measures that do not aim at redistribution per se, but have redistributive consequences, are subject to controversial discussions. It emerges clearly from these debates that preferences for redistribution vary significantly between individuals. What explains this variation? As emphasized by Giuliano and Spilimbergo (2014, p. 787), our knowledge on this issue is still very limited: "Despite the crucial role of preferences for redistribution in explaining institutional outcomes, little empirical work has been done on how these preferences are formed and how and why they change over time".

A well-established finding in the empirical literature is the negative relationship between preferences for redistribution and income (Fong, 2001; Alesina and La Ferrara, 2005; Alesina and Fuchs-Schündeln, 2007; Alesina and Giuliano, 2011; Luttmer and Singhal, 2011; Giuliano and Spilimbergo, 2014; Owens and Pedulla, 2014; Powdthavee and Oswald, 2014).[1] A simple explanation for this pattern is self-interest: While high-income individuals want less redistribution to avoid high taxes, low-income individuals want to benefit from transfers and thus support more redistribution.

In this study, we argue that self-interest might not represent the full story. Empirical evidence suggests that preferences for redistribution are not only driven by self-interest, but also by individuals' views on what is a fair distribution of income, henceforth *fairness views* (Cappelen et al., 2007; Almås et al., 2010; Cappelen et al., 2010, 2013). In our experiment, we show that relative income has a causal effect on these fairness views. This suggests that income affects individuals' preferences for redistribution for reasons that go beyond the self-interest channel – because it also changes their view on what is a fair income distribution.

The studies revealing a negative relationship between preferences for redistribution and income cannot tell whether this is due to a causal effect of income on fairness views, and, therefore, whether the observed negative relationship goes beyond reasons of self-interest. This lack of evidence can be easily attributed to the endogeneity of income and/or to the difficulty

[1] All of these papers use survey data. Kataria and Montinari (2012) and Durante et al. (2014) provide experimental evidence for a negative relationship between income and tax choices. Agranov and Palfrey (2014) obtain an analogous result for the relationship between productivity and tax choices.

of disentangling the effect of fairness views from selfish motives when eliciting preferences for redistribution from field data.[2] Experiments represent, therefore, a useful complementary tool to address both of these issues.[3]

A series of experimental papers focuses on understanding the different types of fairness views present in society (Frohlich et al., 2004; Cappelen et al., 2007; Almås et al., 2010; Cappelen et al., 2010, 2013; Möllerström et al., 2014). These papers, however, treat fairness views as exogenous and do not investigate how they are formed or why they may vary among individuals. The determinants of these fairness views, and in particular the potential role of income, remain, therefore, largely unknown.[4,5]

This study reports the results from a laboratory experiment that was designed to investigate (1) if individuals' relative income affects their fairness views and (2) whether this effect depends on how the income is generated. The experiment consisted of an income generation phase and a distribution phase. In the income generation phase, participants received a high or a low income either through luck or through an effort-based tournament. In the distribution phase, we asked a subset of subjects to make distributive decisions over the incomes of two other pairs of subjects – one pair in which income differences were due to luck, and one in which income differences were due to effort. Thus, in contrast to previous studies, the distributors in our experiment were neither stakeholders, as they had no monetary stakes when making the decisions, nor were they impartial spectators, as they had participated in the income generation phase. This novel design enabled us to test how the distributors' outcomes in the income generation phase – not only the relative income but also whether the latter was generated by luck or by effort – affected their fairness views. Furthermore, we elicited fairness views about the distribution of

[2]Even when income is exogenously generated, as in Owens and Pedulla (2014) and Powdthavee and Oswald (2014), individuals who experience a positive income shock may report a lower preference for redistribution because of selfish motives, i.e., to reduce the tax burden at their new position in the income distribution, and/or because their fairness views become less egalitarian. In this latter case, but not necessarily in the former, individuals would vote for low redistribution even when they have no private interests at stake. This difference in motives, however, is hardly observable in field data.

[3]A related strand of literature focuses on the relationship between *giving* and income (Buckley and Croson, 2006; James and Sharpe, 2007; Piff et al., 2010; Erkal et al., 2011). While these papers obtain mixed results, they cannot clarify the relationship between fairness views and income either. On the one hand, this is due to the challenge of inferring fairness views from giving behavior, for which it is necessary to have variation in the way how income differences between givers and receivers were generated, as well as to disentangle selfish motives from fairness motives, e.g. through the estimation of a structural model as introduced by Cappelen et al. (2007). The papers focusing on the relationship between income and giving satisfy neither of these two requirements. Note, however, that the results of Erkal et al. (2011), who find in their experiment that high-income individuals give less than low-income individuals, at least suggest that fairness views of the participants differ across incomes. A further reason why the studies on the relationship between income and giving cannot clarify a causal effect of income on fairness views is the endogeneity of income in these studies. However, in the experiment of Buckley and Croson (2006) and in one treatment of Erkal et al. (2011), income is exogenous, but has no effect on giving.

[4]Other studies try to investigate whether fairness principles may be chosen in an opportunistic way, i.e., to maximize one's own monetary payoff (Rodriguez-Lara and Moreno-Garrido, 2012; Ubeda, 2014; Tokumaru, 2014). In a related study, Becchetti et al. (2011) analyze how the choice of a distribution criterion depends on the knowledge of one's position in the income distribution. In our experiment, however, since participants had no monetary stakes when making their redistributive decisions, such opportunistic behavior was ruled out by design.

[5]Barr et al. (2012) relate the participants' social status to their behavior in a dictator game. They find that high-status individuals tend to acknowledge entitlement owing to effort more than low-status individuals. They cannot, however, show that this is due to a causal effect of social status, as they cannot control for self-selection.

income from luck and about the distribution of income from effort.

Our results can be summarized as follows. First, we find that low-income individuals redistribute significantly more than high-income individuals when the source of income differences is the same as the one they experienced themselves. That is, when inequalities are due to luck (effort), an individual who received a low income by lack of luck (effort) redistributes significantly more than an individual who received a high income by luck (effort). The effect remains unchanged when controlling for individual performance in the effort-based tournament, suggesting that self-selection into different income levels does not drive the results. We thus conclude that relative income, and how the latter is generated, has a causal effect on individuals' fairness views, and therefore, on preferences for redistribution beyond the self-interest channel.

Second, subjects' responses in a post-experimental questionnaire suggest that the effect of income on redistributive choices comes along with a consistent shift in beliefs about the degree of individuals' responsibility for a specific outcome. More specifically, individuals who received a high income by effort (luck) attribute outcomes in the tournament (lottery) more to internal factors (i.e., factors under their control) compared to individuals who received a low income by lack of effort (luck). One interpretation of these findings is that the effect of relative income on fairness views results from a change of beliefs about one's responsibility over an outcome. This belief follows a self-serving bias in responsibility attribution, that is, it takes credit for personal successes and denies responsibility for failures (Miller and Ross, 1975; Bradley, 1978).

This study provides two main contributions to the literature. First of all, we enrich the literature on the determinants of preferences for redistribution. We show that relative income affects preferences for redistribution through its effect on views about what is a fair distribution of income. Second, we contribute to the growing literature on fairness views. We show that people's fairness views are not fixed, but endogenous to the process of income generation, as they depend on people's relative income. Furthermore, our results on the self-serving bias in responsibility attribution emphasize the importance of beliefs for fairness views.

The study also has important implications for our understanding of how societies think about redistribution. Our results suggest that personal income changes individuals' views about a fair distribution of income in society. This implies that the conflict between rich and poor in the debate about redistribution is not only a battle of personal interests, but also of different ideologies. This difference in ideologies is such that it increases the discrepancy in preferences for redistribution that is already caused by selfish motives. This means that there will be disagreement between rich and poor about income redistribution even if people are able to abstract from their own personal stake in this redistribution. Our results further imply that the differences in ideologies between rich and poor are, at least to some degree, the result of different individual outcomes in the process of income generation. As a consequence, an increase in income inequality is likely to boost the polarization in political preferences, making it harder for societies to reach a consensus about the optimal level of redistribution in the long run.

In the following, we describe the design, experimental procedures and identification strategies in greater detail (section 4.1), present the results (section 4.2), discuss potential channels underlying the effects (section 4.3), and conclude (section 4.4).

4.1.1. Design

The experiment consisted of two phases: An *income generation phase* and a *distribution phase*. At the beginning of the experiment, we instructed the participants only about the income generation phase, while telling them that the second phase would concern the distribution of the incomes generated in the first phase. After the income generation phase had been completed, we explained details of the distribution phase. We describe the two phases below.

Income generation phase

At the beginning of the income generation phase, the participants were randomly paired. Next, they executed a real effort task. We used a variant of the slider task introduced by Gill and Prowse (2012). This computerized task consists of a screen containing 48 sliders, which are initially positioned at zero and can be moved as far as 100 using the mouse cursor.[6] The goal is to set as many sliders as possible to exactly fifty within 120 seconds. In our experiment, we confronted the participants with a series of five of these screens, each for 120 seconds. The total number of sliders adjusted to exactly fifty in the five screens represented the participants' *effort* in the task. Before the sequence of five screens started, the participants had 60 seconds to practice the task. After the time was up, the participants saw their effort on the computer screen.

After all participants had completed the task and had seen their effort, every pair of participants was randomly assigned to one of two treatments – a lottery treatment and a tournament treatment. More specifically, half of the pairs within a session was assigned to the tournament treatment, while the other half was assigned to the lottery treatment.

Each treatment implied a different income generation process in assigning a high and a low income within a pair. In the tournament treatment, a high income was assigned to the participant in the pair with higher effort in the task, and a low income to the other participant. In the lottery treatment, the two incomes were randomly assigned within the pair. The income levels were constant across both treatments. We paid 25 Swiss Francs (CHF) as high income and CHF 5 as low income.[7] At the end of the income generation phase, the participants observed their own income, the income of the participant they were paired with, and the process that had generated the incomes within their pair. They did, however, not observe the efforts of the other participants in the tournament.

The income generation phase thus produced four types of participants (see Table 4.1): Those with high income from the lottery (HiLot), those with low income from the lottery (LoLot), those with high income from the tournament (HiTour), and those with low income from the tournament (LoTour).

[6] We deactivated the mouse wheels and keyboards by software, so that the participants could only use the mouse cursor to manipulate the sliders.

[7] At the time of the experiment, the exchange rate was CHF 1.22 per € and CHF 0.89 per US$.

Table 4.1: Types in the income generation phase

	Lottery	Tournament
High income (CHF 25)	HiLot	HiTour
Low income (CHF 5)	LoLot	LoTour

Distribution phase

In the subsequent distribution phase, each pair was randomly assigned to one of two roles – *distributors*, who kept their income from the first phase, and *non-distributors*, whose incomes were subject to redistribution by the distributors. Per session, there were two pairs of non-distributors – one from those pairs whose incomes had been generated through the lottery, and one from those pairs whose incomes had been generated through the tournament.

In the next step, the distributors were asked to distribute the total income that was earned within each non-distributor pair between both members of that pair. This means that every distributor made two distributive decisions: One for the pair from the lottery treatment, and one for the pair from the tournament treatment.[8] The order of presentation was random, but it was always made very clear for which pair the decision was currently made. Before confirming the redistributive choices, the distributors had the possibility to go back and change the choices for both pairs if they wanted to. The decisions were such that for each pair, the distributors had to enter how much of the total income (CHF 30) should be distributed to the participant who had earned CHF 25, and how much of it should be distributed to the one who had earned CHF 5. The amounts given to both participants had to sum up to CHF 30 and were entered in multiples of CHF 0.5. At the end of the distribution phase, the decisions of one distributor were randomly chosen and applied to the non-distributor pairs. As final payoff, the distributors received their income from the first phase, while the non-distributors received what had been distributed to them by the randomly chosen distributor.

4.1.2. Procedural details

In total, 262 subjects participated in the experiment. We conducted 8 sessions with 32 to 34 participants each. The experiment lasted about an hour. It took place at the computer lab of the University of Zurich, Switzerland, in March and April 2014. We recruited our participants from local university students, excluding economics and psychology majors.[9] To program and conduct the experiment, we used the software z-Tree (Fischbacher, 2007b). The instructions used neutral language, avoiding terms like “tournament”, “winner”, or “distributor”. We kept the participants’ identity and their decisions anonymous throughout the experiment. The average payoff was CHF 25 (ca. US$ 28), including a participation fee of CHF 10 (ca. US$ 11). We paid all payoffs individually and in private immediately after the experiment.

[8]While this may generate a demand effect on how to distribute income from different sources, this does not generate a demand effect for the main question addressed in this study, namely, if there is any difference in distributive decisions between individuals with different relative income.

[9]The recruitment was conducted with the software hroot (Bock et al., 2012b).

4.1.3. Identification strategy

We use the distributors' decisions in the distribution phase to infer their views on what is a fair distribution of income – both for situations in which income differences are due to luck (the lottery treatment) and for situations in which income differences are due to effort (the tournament treatment).[10]

We believe that the distributive decisions identify the participants' fairness views for the following reasons: First, since the distributors' incomes were unaffected by their own distributive decision, there was no self-interest involved in the redistribution. Second, as the instructions made very clear that the distributors' incomes were not subject to any decisions by the non-distributors, the distributors had no reason to make accommodating distributive decisions in order to induce reciprocal behavior on the side of the non-distributors. Third, there was no reason for strategic decisions, since a distributor's decision would either be discarded or fully implemented. Fourth, distributive decisions were made only after the incomes had been generated. Furthermore, details about the distribution phase were unknown in the income generation phase. Therefore, distributive decisions had no incentive effects in the first stage.[11]

The variation of the distributors' income in the first phase allows us to identify the effect of relative income on their fairness views. First, we compare the distributive decisions of those with high income from the lottery (HiLot) and those with low income from the lottery (LoLot). Since the selection of participants into both types was random, this gives us the causal effect of relative income from luck. Second, to obtain the effect of relative income from effort, we compare the decisions of those with high income from the tournament (HiTour) and those with low income from the tournament (LoTour). In this comparison, however, we need to control for self-selection. This is because more competitive or able individuals, who are more likely to end up with high income from the tournament by exerting systematically higher effort, may have different fairness views than others. As a consequence, differences in fairness views between HiTour and LoTour could simply result from a higher share of competitive or more able individuals among type HiTour. We control for self-selection by exploiting the random variation in income between individuals with similar effort in the tournament. Indeed, among individuals with similar effort, some were randomly matched with a participant with lower effort than theirs and thus received a high income, while others were randomly matched with a participant with higher effort than theirs and thus received a low income. The causal effect of income from effort can be identified through the randomness of this matching.[12] Further details about our strategy to control for selection will be given below.

By keeping the distributors' income levels constant and varying the process that generated their income, we test whether there is an effect of the source of income on people's fairness views. This means that we separately compare the distributive decisions of those with high

[10] Clearly, the outcome of the tournament also depends on luck. Potential random factors are ability to handle the mouse, physical and mental state at the day of the experiment, and, most importantly, the performance of the opponent. This is, however, realistic in that there is no real-world income generation process which depends solely on effort. We therefore believe that it is still reasonable to interpret income from the tournament as income acquired through effort.

[11] We cannot rule out that subjects who are not motivated by any fairness consideration made their distributive choices at random. However, this only adds noise to the data and thus, if anything, makes it harder to find any effect.

[12] Note that if there were no randomness involved in the generation of income from effort, it would not be possible to identify any causal effect.

Table 4.2: Identification strategy

Comparison	Effect
HiLot vs. LoLot	income from luck
HiTour vs. LoTour	income from effort
HiLot vs. HiTour	income generation for high income
LoLot vs. LoTour	income generation for low income

income (HiLot and HiTour) and of those with low income (LoLot and LoTour). While the selection into both income generation processes was random, there has still been a self-selection of individuals into both types from the tournament (HiTour and LoTour). Therefore, we also control for selection in the latter two comparisons. A design feature that facilitates this is the fact that all participants, before being allocated to the treatments, were required to complete the effort task. While this feature probably increased the discrepancy between the experimental and the natural environment, it did not only allow us to control for selection, but also avoided that individuals who were in the tournament treatment had an informational advantage about the experience of solving the task. The latter could have led to different redistributive choices compared to individuals in the lottery treatment.[13] Table 4.2 summarizes our identification strategy.

4.2. Results

First of all, we confirm the well-established result that inequalities which are due to effort tend to be accepted more than inequalities which are due to luck (Cappelen et al., 2007; Almås et al., 2010; Cappelen et al., 2010; Krawczyk, 2010; Rustichini and Vostroknutov, 2014; Kataria and Montinari, 2012; Vostroknutov et al., 2012; Cappelen et al., 2013; Durante et al., 2014).[14] As Figure 4.1 shows, the average amount distributed to the individual with low income from the tournament (LoTour) is approximately 40 percent lower (signed-rank p=0.00) than the average amount distributed to the participant with low income from the lottery (LoLot). Thus, we can be confident that the distributive situations induced in our experiment are comparable to those in earlier studies, and that even though the distributors did not have any material interest at stake, their fairness motives were strong enough to incentivize their redistributive choices.

[13]It is important to mention, however, that we cannot fully rule out informational asymmetries between participants in different treatments. More specifically, in the tournament treatment participants could infer from their income whether the effort of the participant they were matched with was higher or lower than theirs. Therefore, compared to individuals in the lottery treatment, individuals in the tournament treatment had an informational advantage through their performance in the task relative to others. It is not clear, however, how this might affect the comparison we are interested in. On the other hand, the alternative – also informing the participants in the lottery treatment about how their performance in the task compared to the performance of the participant they were matched with – bears the risk of mitigating the treatment effect: Lottery winners may not feel as a winners anymore if they knew with certainty that they would have won the tournament anyway.

[14]Consistent with these experimental findings are the results of Fong (2001), Bullock et al. (2003), Alesina and La Ferrara (2005), Alesina and Fuchs-Schündeln (2007), Isaksson and Lindskog (2009) and Alesina and Giuliano (2011). Using survey data, they show that preferences for redistribution are increasing in the individuals' belief to which degree economic outcomes are the result of luck rather than of effort. They show that preferences for redistribution are decreasing in the individual's level of subjective freedom.

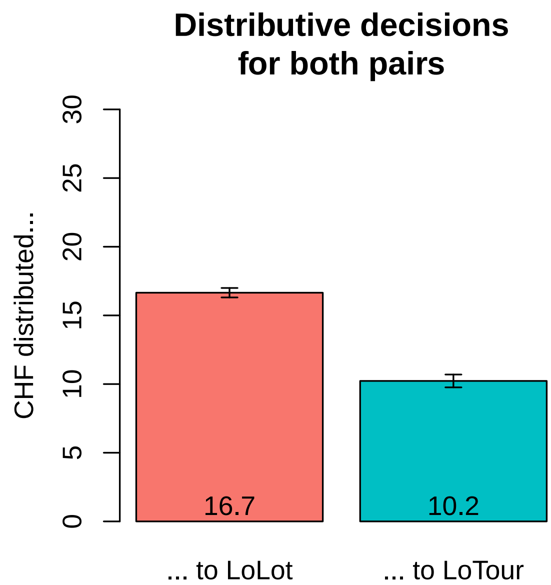

Figure 4.1: Decisions for both distributive situations. Heights of bars and values at bottom of bars correspond to means of amount (in CHF) distributed to the participant with low income. Lengths of whiskers at top of bars are equal to standard errors of the means.

We now focus on the differences in distributive decisions between types. Out of our 230 distributors, we observe 59 of type HiLot and 59 of type LoLot, as well as 56 of type HiTour and 56 of type LoTour. Figure 4.2 shows the distributive decision of all four types for the pair from the lottery (left panel) and for the pair from the tournament (right panel).

4.2.1. Relative income from luck

We first analyze the effect of relative income from luck. On average, HiLot distributes about CHF 2.5 or 13 percent less to the non-distributor of type LoLot than LoLot does (rank-sum p=0.01). Surprisingly, LoLot distributes even significantly more than half of the total income that was earned in the pair to LoLot, which essentially reverses the inequality in this pair (CHF 18.5, signed-rank p=0.00).[15] This result, which could be interpreted as in-group bias or spite towards lottery winners on the side of the lottery losers, is consistent with previous evidence.[16] On the contrary, we find no difference in how much HiLot and LoLot distribute to the non-distributor of type LoTour (rank-sum p=0.63).[17] We conclude:

Result 6 *We find a causal effect of relative income from luck on fairness views. The effect is such that individuals with low income from (lack of) luck redistribute significantly more than individuals with high income from luck when inequalities are due to luck.*

[15]The amount distributed to LoLot by HiLot is not significantly higher than half of the total income (signed-rank p=0.16).

[16]Rustichini and Vostroknutov (2014) find in a different experimental setting that individuals are willing to reduce the lottery winnings of others at a cost to themselves.

[17]See Figure C.1 for histograms of the distributive decisions of HiLot and LoLot for the pair from the lottery.

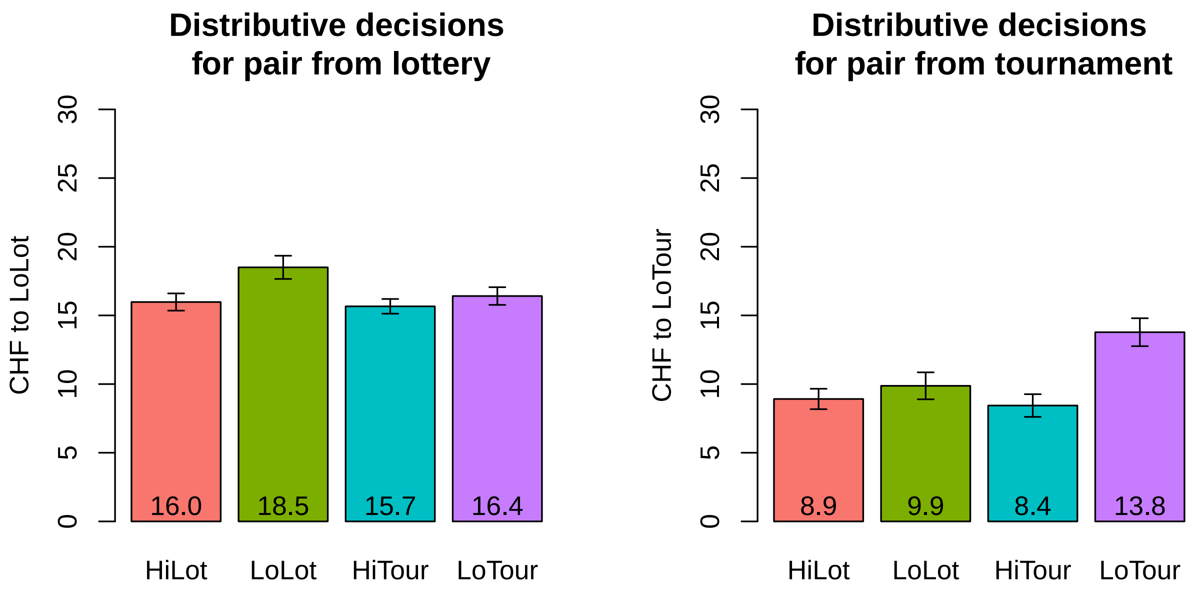

Figure 4.2: Distributive decisions of the four types. Heights of bars and values at bottom of bars correspond to means of amount (in CHF) distributed to the participant with low income. Lengths of whiskers at top of bars are equal to standard errors of the means.

4.2.2. Relative income from effort

Next, we consider the effect of relative income from effort by comparing the distributive decisions of HiTour and LoTour. There is no difference in how much both distribute to the non-distributor of type LoLot (rank-sum p=0.43). However, HiTour distributes about CHF 5 or 40% less to the non-distributor of type LoTour than LoTour does.[18] This difference is significant (rank-sum p=0.00), but, as argued above, may be due to selection effects.

In order to control for potential selection, we regress the amount in CHF distributed to the participant with low income from the tournament on a dummy variable for HiTour, and various controls for the distributors' effort in the income generation phase. We use linear and quadratic specifications, as well as fixed effects for effort bins of different sizes. An effort bin of size x means that we split the range of observed effort levels (0 to 169) into intervals of size x, and allow for a common fixed effect among all distributors whose effort levels are in the same interval. This keeps the distributors' effort level constant, so that the dummy variable captures only the variation that is caused by switching from low income to high income. This variation is purely exogenous: If the distributors' effort is fixed, whether they received high income in the tournament depends on the random event of whether they had been matched with a partner who had a lower effort than themselves. As a result, the coefficient of the dummy variable is an unbiased estimate of the effect of income from effort, while the coefficients for the various controls measure the selection effect. Note that an alternative interpretation of the coefficient of the dummy variable is that it measures the effect of luck that made effort pay off.

Table 4.3 shows the regression results. They suggest that the difference in distributive de-

[18] See Figure C.2 for histograms of the distributive decisions of HiTour and LoTour for the pair from the tournament.

Table 4.3: Effect of income from effort on CHF distributed to LoTour

Control for effort	None	Linear	Quadratic	FE(10)	FE(5)	FE(2.5)
Constant	13.78***	16.16***	18.33***	15.00**	15.00**	15.00**
	(0.93)	(2.60)	(4.27)	(7.03)	(7.09)	(7.28)
HiTour	-5.34***	-4.50***	-4.72***	-3.92**	-3.69*	-4.05*
	(1.31)	(1.57)	(1.61)	(1.76)	(1.91)	(2.13)
F-test contr. (p)		0.330	0.506	0.677	0.725	0.844
N	112	112	112	112	112	112
R^2	0.13	0.14	0.14	0.22	0.29	0.38
Adj. R^2	0.12	0.12	0.12	0.10	0.08	0.03

Ordinary least squares regressions. Dependent variable: CHF distributed to LoTour. Sample: HiTour and LoTour. FE(x) means fixed effects for effort bins of size x. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Standard errors in parentheses.

cisions between HiTour and LoTour is not caused by selection, but by realized income itself. In fact, the estimate of the coefficient of the dummy variable is always negative and at least marginally significant. Furthermore, we can never reject the joint hypothesis that the coefficients of the controls are all zero (see row "F-test contr. (p)" in Table 4.3), suggesting that effort, and thus selection, has no predictive power. We believe that a bin size of 2.5 is sufficient to control for selection. Otherwise, one would have to argue that distributors whose effort levels differ by 2.5 or less units both exhibit a systematically different probability of receiving high income and differ significantly in their fairness views – a case that is unlikely.[19,20] Hence, we obtain:

Result 7 *We find a causal effect of relative income from effort on fairness views. The effect is such that individuals with high income from effort are less averse to inequalities that are due to effort than individuals with low income from (lack of) effort. The effect is entirely driven by the luck that made the effort of high-income individuals pay off.*[21]

4.2.3. Income generation

We now investigate whether, keeping the amount of income constant, the source of this income has an effect on fairness views. When comparing the decisions of distributors with high income (HiLot and HiTour), we find no difference in how much both distribute to LoLot and to LoTour (ranks-sum p=0.58 and p=0.45), suggesting that there are no differences in distributive decisions between income generation processes for high income. However, when we compare the decisions of distributors with low income (LoLot and LoTour), the picture is different. On the one hand, LoLot distributes more to non-distributors of type LoLot than LoTour does.

[19] With a bin size of 5 or 2.5, the coefficient of the dummy variable is only marginally significant. Note that there is a tradeoff when decreasing the bin size further: While the control of the selection effect improves, the variation in the dummy variable decreases, because there are fewer distributors with different income levels per bin. Hence, an explanation for the lower significance with a bin size smaller than 10 is the limited sample size.

[20] Note that the amount distributed to HiLot is restricted to the interval $[0, 30]$. When using a Tobit model rather than ordinary least squares to take this censoring into account, the estimate of the coefficient of the dummy variable is always significant.

[21] This contrasts with Erkal et al. (2011), who attribute their finding of a negative relationship between giving and income primarily to self-selection.

This difference is close to being marginally significant (rank-sum p=0.10).[22] On the other hand, LoTour distributes significantly more to non-distributors of type LoTour than LoLot does (rank-sum p=0.01). To control for selection, we proceed analogously as for the effect of income from effort and regress the amounts distributed to each participant on a dummy for LoTour, as well as on various controls for effort. Table C.1 and Table C.2 show the results. The estimates for the coefficients of the dummy variable are at least marginally significant with linear and quadratic controls for effort.[23] We conclude:

Result 8 *There is a causal effect of the income generation process on the fairness views of low-income individuals, as the latter become more averse against the sources of inequalities that made themselves poor. There is no evidence for an effect of the income generation process on the fairness views of high-income individuals.*

4.3. Channel

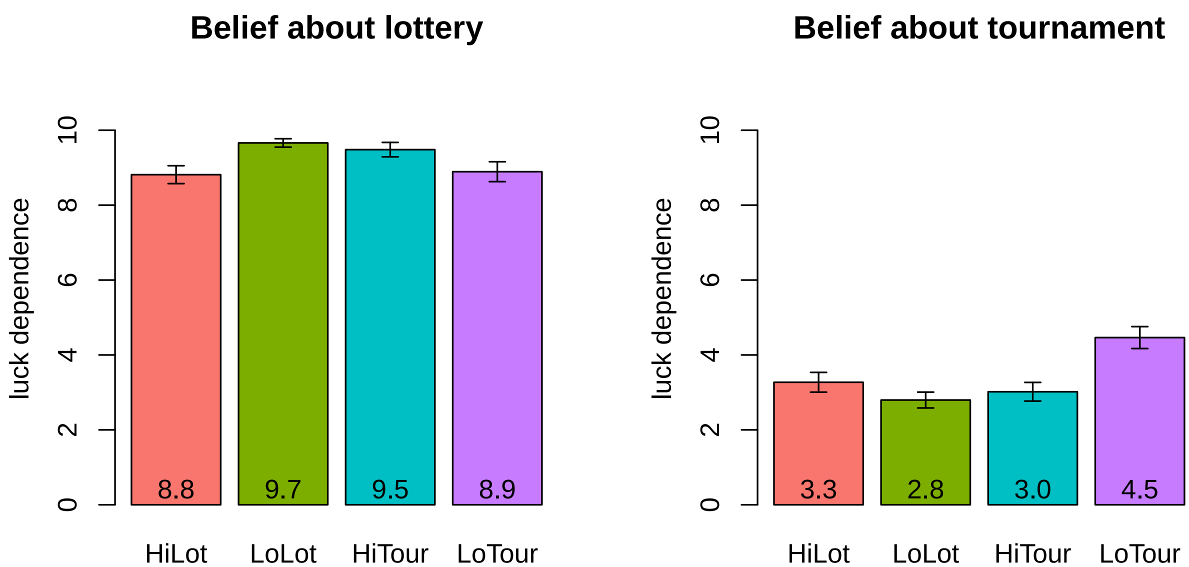

Figure 4.3: Beliefs about income generation processes. Heights of bars and values at bottom of bars correspond to means of belief about luck dependence of the process. Lengths of whiskers at top of bars are equal to standard errors of the means.

Different explanations, not necessarily mutually exclusive, can account for the observed variation in the redistributive decisions, and thus in the fairness views, of the four types of distributors. One explanation for the results is a self-serving bias in attribution of responsibility. Earlier research has demonstrated that people take credit for personal successes and deny responsibility for failures (Miller and Ross, 1975; Bradley, 1978). More specifically, successful

[22]When using a t-test, we obtain marginal significance of the difference (p=0.05).
[23]When using the Tobit model, we also obtain a marginally significant estimate when using fixed effects for effort bins of size 10.

individuals tend to attribute their outcome to circumstances under their control (so-called internal factors), whereas unsuccessful individuals tend to attribute their outcome to circumstances not under their control (so-called external factors). For our experiment, this would predict that high-income individuals from the tournament (HiTour) tend to attribute the outcome of the tournament more to internal factors than low-income individuals from the tournament (LoTour). Analogous predictions would hold for high-income and low-income individuals from the lottery (HiLot and LoLot).[24] Given the well-established result that individuals favor a more equal distribution of income when the latter is due to luck – an external factor – rather than effort or choice – which are internal factors – (see discussion in section 4.2), this would explain our observations for redistributive behavior: If distributors of type HiTour attribute the outcome of the tournament less to external factors than LoTour, they would redistribute less than LoTour in the pair of non-distributors whose incomes were generated in the tournament. A similar argument would hold for the distributors of type HiLot and LoLot.

We test this hypothesis of self-serving bias by analyzing the participants' responses to a survey conducted at the end of the experiment. Participants were asked to state, on a scale from 1 to 10, to what extent they thought that the outcome in the tournament treatment was due to effort rather than to luck, where "1" represented "all due to effort" and "10" represented "all due to luck". Similarly, the participants were asked to choose from 1 to 10, to what extent they thought that the outcome in the lottery treatment was due to "individual attributes (e.g. karma, religiousness)" rather than to luck, where "1" represented "all due to individuals attributes" and "10" represented "all due to luck".[25]

Figure 4.3 shows the average beliefs of all four types of distributors regarding the lottery (left panel) and the tournament (right panel).

Consistent with the self-serving bias hypothesis, we find that HiTour distributors believe significantly less (rank-sum p=0.00) in the luck dependence of the tournament than LoTour distributors do. This result does not change when controlling for self-selection (see Table C.3).[26] Similarly, although to a smaller extent, HiLot distributors believe significantly less (rank-sum p=0.00) in the luck dependence of the lottery than LoLot distributors do.[27] While the latter might seem surprising, as individuals cannot be responsible for the outcome of a lottery, this is consistent with previous evidence by Gurdal et al. (2013), which shows that principals blame agents for the outcome of a lottery regardless of the agents' choices. We obtain:[28]

Result 9 *High-income individuals believe less in the luck dependence of their outcomes compared to low-income individuals.*

Thus, result 9 identifies a self-serving bias on responsibility attribution as a potential channel

[24]It might seem absurd at first why anyone would believe that internal factors play a role in the lottery – whose outcome is random. However, certain philosophies such as Buddism view an individual's fortune as the result of past actions. Hence, it is at least possible that some high-income individuals from the lottery attribute their success to such internal factors. This perspective would deny pure randomness of the lottery.

[25]We always asked the question about the outcome of the tournament treatment first.

[26]HiTour and LoTour also differ in their belief regarding the lottery (rank-sum p=0.02).

[27]For histograms of the beliefs, see Figure C.3 and Figure C.4.

[28]Similar results follow when comparing beliefs between individuals with the same income, but different income generation process. LoTour believes significantly more in the luck dependence of the tournament than LoLot (rank-sum p=0.00), and vice-versa (rank-sum p=0.01). HiLot attributes outcomes from the lottery significantly more to internal factors than HiTour (rank-sum p=0.00). The reverse, however, is not true (rank-sum p=0.56).

of the effect of relative income and of its generation process on individuals' fairness views.

Note that another explanation for the variation in the redistributive decisions is a direct in-group bias: Be nicer to those who are similar to yourself. If individuals with the same relative income and the same process of income generation develop a group-identity feeling, this may explain why, on average, non-distributors receive more from a distributor of their own type than from a distributor of a competing type.[29] This applies in particular to low-income individuals from lack of luck, who redistribute significantly more than half to low-income individuals from the lottery. Previous evidence on redistributive choices has indeed shown the effect of in-group favoritism based on race (Luttmer, 2001), on age and gender (Cardenas and Sethi, 2010), on risk-taking choices (Costard and Bolle, 2011), and on field of studies (Klor and Shayo, 2010). In our experiment, distributors had only information about the individuals' relative income and the process that generated that income. Therefore, these were the only characteristics that may have generated a group-identity feeling. Nevertheless, we cannot rule out that a pure in-group bias is also playing a role in the redistributive decisions (especially for low-income individuals from the lottery) besides the self-serving bias on responsibility attribution, as both channels cannot be distinguished in our data.[30]

Finally, we would like to point out a further implication of result 9: It suggests that the individuals' experience in terms of their economic outcomes affects their beliefs about how these outcomes have come about. This aligns well with previous papers that emphasize an effect of past experience, such as communism (Alesina and Fuchs-Schündeln, 2007) and recessions (Giuliano and Spilimbergo, 2014), on beliefs.[31] We add to this literature by showing that idiosyncratic events, not only phenomena affecting the society as a whole, play a role in the formation of beliefs about inequality, too. Furthermore, our findings suggest a substantial degree of subjectivity in these beliefs: Even when the luck dependence of an income generation process in known and fixed (as in the lottery), there are individuals whose beliefs deviate from this objective truth (HiLot).

4.4. Conclusion

In this experiment, we vary the participants' income and the way their income is generated. We then elicit their fairness views through their redistributive decisions over other participants' incomes. We find a causal effect of relative income on fairness views. This effect is such that in comparison to high-income individuals, low-income individuals redistribute significantly more when the source of inequalities is the same as the one that made themselves poor. We then argue that an explanation for this result is a self-serving bias on responsibility attribution, which is supported by our data: Compared to low-income individuals, high-income individuals

[29]On average, HiLot receives CHF 14.0 from HiLot, but only CHF 11.5 from LoLot. Similarly, LoLot receives CHF 18.5 from LoLot, but only CHF 16 from HiLot. Analogous comparisons hold for HiTour and LoTour: HiTour receives CHF 21.6 from HiTour, but only CHF 16.2 from LoTour. LoTour receives 13.8 from LoTour, but only 8.4 from LoLot.

[30]When regressing the amount distributed to LoTour on a dummy variable for HiTour and beliefs for the tournament, both variables have explanatory power for the distributive decisions. This suggests that income affects distributive choices not only through a change of beliefs. Therefore, self-serving biases in the belies may not the be the only relevant channel.

[31]Theoretical papers focusing on belief formation and how it affects redistributive policies are Piketty (1995), Alesina and Angeletos (2005) and Benabou and Tirole (2006).

tend to believe more that their outcome is the result of internal rather than external factors.

Our results suggest that personal income changes individuals' views about a fair distribution of income in society. More specifically, we show that personal income may increase the acceptance of income differences. This would create conflicting ideologies between rich and poor and increase the discrepancy in preferences for redistribution beyond what is already caused by selfish motives. As a consequence, rising income inequality, by increasing the polarization in political preferences, is likely to make it even harder for societies to reach a consensus about redistribution in the long run.

One should, however, always be cautious when generalizing from the results of a particular study. Note that what we identify is essentially an effect of relative income made in an *experiment* on individuals' views about what is a fair distribution of income from that *experiment*. Of course, the fair distribution of income in society is a much more fundamental question than that of a fair distribution of experimental income. Furthermore, the experiment was designed to test the validity of some hypotheses in isolation, namely, in the absence of additional features that may play a role in a natural environment. For instance, in the field, individuals do not actually make direct redistributive decisions over other people's incomes, but use their voting right to influence redistribution. Furthermore, their voting decisions often affect their personal income in addition to the income of others. While new treatments can always be run to study the role of each of these environmental features, it is precisely the absence of these features in our experiment that allowed us to rule out selfish motives and strategic behavior and, thus, to identify the causal effect of relative income on individuals' fairness views. These fairness views have been shown to be a significant determinant of preferences for redistribution in the laboratory and in the field. Therefore, we believe that our study, by increasing our understanding of how these fairness views may be formed, leaves a message that is relevant for future theoretical and empirical studies on distributive justice: Fairness views about income distribution should not be treated as exogenous, as they are likely to depend on individuals' relative income.

Appendix A

Appendix: Chapter 2

Proof of Proposition 1

First, notice that by replacing the optimal ex-post level of effort in (9), the incentive compatibility constraint in (7) can be rewritten as

$$U_i(\theta_i) = \max_{\hat{\theta}_i \in \Theta} E_{\theta_{-i}}\Big(p_i(\hat{\theta}_i, \theta_{-i}) + q_i(\hat{\theta}_i, \theta_{-i})\tfrac{1}{2}\theta_i^2 G(m_A - m_i(\hat{\theta}_i, \theta_{-i}))^2\Big)$$

By the Envelope Theorem, this implies:

$$U_i'(\theta_i) = E_{\theta_{-i}}\Big(q_i(\theta)\theta_i G(m_A - m_i(\theta))^2\Big)$$

$$U_i(\theta_i) = U_i(0) + \int_0^{\theta_i} E_{\theta_{-i}}\Big(q_i(t_i, \theta_{-i}) t_i G(m_A - m_i(t_i, \theta_{-i}))^2\Big) dt_i$$

The expected payment to agent i is then

$$p_i(\theta_i) = E_{\theta_{-i}} p_i(\theta) = p_i(0) + \int_0^{\theta_i} E_{\theta_{-i}}\Big(q(t_i, \theta_{-i}) t_i G(m_A - m(t_i, \theta_{-i}))^2\Big) dt_i - E_{\theta_{-i}}\Big(q_i(\theta)\tfrac{1}{2}\theta_i^2 G(m_A - m_i(\theta))^2\Big)$$

The participation constraint binds for the lowest type, thus $p_i(0) = 0$. This proves equation (13).

Let now turn our attention to the principal's expected utility. After replacing the optimal effort level in (9), equation (6) becomes

$$E(V_D) = E_\theta\Big(\sum_{i=1}^{n} q_i(\theta)\theta_D\theta_i G(m_i(\theta) - m_D) G(m_A - m_i(\theta)) - p_i(\theta)\Big) \tag{A-1}$$

This can be rewritten as

$$E(V_D) = \sum_{i=1}^{n} \int_0^1 \Big(E_{\theta_{-i}}\Big(q_i(\theta)\theta_D\theta_i G(m_i(\theta) - m_D) G(m_A - m_i(\theta))\Big) - p_i(\theta_i)\Big) f(\theta_i) d\theta_i \tag{A-2}$$

Substituting the expected payment with equation (13) and interchanging the order of integration in the last term then gives

$$\begin{aligned} E(V_D) &= \sum_{i=1}^{n} \int_0^1 E_{\theta_{-i}} \Big(q_i(\theta)\theta_D\theta_i G(m_i(\theta) - m_D) G(m_A - m_i(\theta)) + q_i(\theta)\frac{\theta_i^2}{2} G(m_A - m_i(\theta))^2 \\ &\quad - \frac{1 - F(\theta_i)}{f(\theta_i)} q_i(\theta)\theta_i G(m_A - m_i(\theta))^2 \Big) f(\theta_i) d\theta_i \end{aligned}$$

which can also be rewritten as

$$\begin{aligned} E(V_D) &= \sum_{i=1}^{n} E_{\theta} \Big(q_i(\theta) \Big(\theta_D\theta_i G(m_i(\theta) - m_D) G(m_A - m_i(\theta)) + \frac{\theta_i^2}{2} G(m_A - m_i(\theta))^2 \\ &\quad - \frac{1 - F(\theta_i)}{f(\theta_i)} \theta_i G(m_A - m_i(\theta))^2 \Big) \Big) f(\theta) d\theta \end{aligned}$$

where $f(\theta)$ is the joint density of $\theta = (\theta_1, ..., \theta_n)$. Since the intrinsic motivation levels are independently distributed, $f(\theta) = f(\theta_1) \times f(\theta_2) \times ... \times f(\theta_n)$. By maximizing with respect to $m_i(\theta)$, I find the optimal mission as a function of the agents' i intrinsic motivation level as in defined in equation (12):

$$\frac{\theta_i - 2\frac{1-F(\theta_i)}{f(\theta_i)}}{\theta_D} = \frac{G'(m_i^* - m_D)}{G'(m_A - m_i^*)} - \frac{G(m_i^* - m_D)}{G(m_A - m_i^*)}$$

The assumption that $G'(0) = 0$ is sufficient for the second order conditions to be satisfied. This proves equation (12).[1] As far as the comparative statics are concerned, if θ_i increases, by the regularity condition of $F(.)$, the LHS in equation (12) increases, so the RHS in equation (12) must also increase, which means that either $G'(m_i - m_D)/G'(m_A - m_i)$ increases or $G(m_i - m_D)/G(m_A - m_i)$ decreases, or both. Since $G(x)$ is decreasing in x, $G(m_i - m_D)/G(m_A - m_i)$ gets smaller as $m_A - m_i$ decreases and $m_i - m_D$ increases. Similarly, since $G(x)$ is decreasing and concave, $G'(m_i - m_D)/G'(m_A - m_i)$ increases as $G'(m_i - m_D)$ decreases (i.e. becomes more negative) and $G'(m_A - m_i)$ increases (i.e. becomes less negative), that is, as $m_A - m_i$ decreases and $m_i - m_D$ increases. This implies that $m_i^*(\theta_i)$ is increasing.

Let me define by $X(\theta_i)$ the equivalent of the virtual valuations in Myerson (1981):

$$X(\theta_i) = \theta_D\theta_i G(m_i^*(\theta_i) - m_D) G(m_A - m_i^*(\theta_i)) + \theta_i \Big[\frac{\theta_i}{2} - \frac{1 - F(\theta_i)}{f(\theta_i)} \Big] G(m_A - m_i^*(\theta_i))^2 \quad \text{(A-3)}$$

By replacing (12) in (A-3), it becomes clear that the virtual valuations are positive for all θ_i. This means that under the optimal mechanism - with $c = 0$ - no type is excluded from the competition. To derive the optimal allocation rule, I look at the derivative of $X(\theta_i)$:

$$\frac{dX}{d\theta_i} = \frac{dX}{dm_i^*}\frac{dm_i^*}{d\theta_i} + \frac{\partial X}{\partial \theta_i}$$

[1] To rule out potential corner solutions, I assume that θ_D is large enough such that $\theta_i > 2\frac{1-F(\theta_i)}{f(\theta_i)} - \theta_D G(0)/G(m_A - m_D)$, $\forall\ \theta_i$.

The product term is equal to zero by the FOC. Thus, we have

$$X'(\theta_i) = \theta_D G(m_i^*(\theta_i) - m_D)G(m_A - m_i^*(\theta_i)) + G(m_A - m_i^*(\theta_i))^2 \Big[\theta_i\Big(1 - \frac{\partial \frac{1-F(\theta_i)}{f(\theta_i)}}{\partial \theta_i}\Big) - \frac{1-F(\theta_i)}{f(\theta_i)}\Big]$$

Rearranging the term above gives the following condition for the positive monotonicity of the virtual valuations:

$$\theta_i > s(\theta_i)^{-1}\Big(\frac{1-F(\theta_i)}{f(\theta_i)} - \frac{\theta_D G(m_i^*(\theta_i) - m_D)}{G(m_A - m_i^*(\theta_i))}\Big) \tag{A-4}$$

where $s(\theta_i) = 1 - \partial[(1-F(\theta_i))/f(\theta_i)]/\partial\theta_i$. From the monotone hazard rate property of $F(.)$, we know that $\partial[(1-F(\theta_i))/f(\theta_i)]/\partial\theta_i < 0$, which implies that $0 < s(\theta_i)^{-1} < 1$. When $(1-F(\theta_i))/f(\theta_i) < \theta_D G(m_i^*(\theta_i) - m_D)/G(m_A - m_i^*(\theta_i))$ it is immediately clear that the condition in (A-4) is always satisfied. By replacing the LHS of (A-4) with the FOC in (12), one can show that the monotonicity of the virtual valuations also holds when $(1-F(\theta_i))/f(\theta_i) > \theta_D G(m_i^*(\theta_i) - m_D)/G(m_A - m_i^*(\theta_i))$:

$$2\frac{1-F(\theta_i)}{f(\theta_i)} - \frac{\theta_D G(m_i^* - m_D)}{G(m_A - m_i^*)} + \overbrace{\theta_D \frac{G'(m_i^* - m_D)}{G'(m_A - m_i^*)}}^{+} > s(\theta_i)^{-1}\Big(\frac{1-F(\theta_i)}{f(\theta_i)} - \frac{\theta_D G(m_i^* - m_D)}{G(m_A - m_i^*)}\Big)$$

Rearranging:

$$\Big(2 - s(\theta_i)^{-1}\Big)\frac{1-F(\theta_i)}{f(\theta_i)} - \Big(1 - s(\theta_i)^{-1}\Big)\frac{\theta_D G(m_i^* - m_D)}{G(m_A - m_i^*)} + \theta_D \frac{G'(m_i^* - m_D)}{G'(m_A - m_i^*)} > 0$$

Since $0 < s(\theta_i)^{-1} < 1$ and $(1-F(\theta_i))/f(\theta_i) > \theta_D G(m_i^*(\theta_i) - m_D)/G(m_A - m_i^*(\theta_i))$, the expression above is always positive. This implies that the optima allocation rule is

$$q_i^*(\theta) = \begin{cases} 1 & \text{if } \theta_i > \max_{\forall j \neq i} \theta_j \\ 0 & \text{otherwise} \end{cases} \tag{A-5}$$

This completes the proof of Proposition 1.[2]

Proof of Proposition 2

Consider the following scoring rule:

$$\begin{aligned} S^*(m,p) \;\; = \;\; & \theta_D m_0^{-1}(m) G(m - m_D) G(m_A - m) - p - \theta_D \int_v^m \frac{\partial m_0^{-1}(s)}{\partial m} G(s - m_D) G(m_A - s) ds \\ & + \int_v^m \frac{1 - F(m_0^{-1}(s))}{f(m_0^{-1}(s))} m_0^{-1}(s) 2G(m_A - s) G'(m_A - s) ds \end{aligned}$$

[2] The monotonocity of q_i^* and m_i^* guarantee that the single crossing differences condition, $\partial U_i^*/\partial\hat{\theta}_i\partial\theta_i > 0$, holds and, therefore, that the incentive compatibility constraint is satisfied.

for $m \in [m_0(0), m_0(1)]$ and where $m_0(.)$ is the optimal mission in equation (12) and v is any real number. From Lemma 1 in Che (1993), I know that under the first- and second-score auction with general scoring rule $S(m,p)$, each agent bids an m that maximizes $S(m,p)+\frac{\theta_i^2}{2}G(m_A-m)^2$. Thus, with scoring rule $S^*(m,p)$ defined above, each agent chooses the mission that maximizes

$$\begin{aligned} Z(\theta_i, m) &= \theta_D m_0^{-1}(m)G(m-m_D)G(m_A-m) - p - \theta_D \int_v^m \frac{\partial m_0^{-1}(s)}{\partial m} G(s-m_D)G(m_A-s)ds \\ &+ \int_v^m \frac{1-F(m_0^{-1}(s))}{f(m_0^{-1}(s))} m_0^{-1}(s) 2G(m_A-s)G'(m_A-s)ds + \frac{\theta_i^2}{2}G(m_A-m)^2 \end{aligned}$$

By the product rule, the expression above can be rewritten as

$$\begin{aligned} Z(\theta_i, m) &= \int_v^m \theta_D m_0^{-1}(s)[G'(s-m_D)G(m_A-s) - G(s-m_D)G'(m_A-s)] \\ &+ \frac{1-F(m_0^{-1}(s))}{f(m_0^{-1}(s))} m_0^{-1}(s) 2G(m_A-s)G'(m_A-s)ds - p + \frac{\theta_i^2}{2}G(m_A-m)^2 \end{aligned}$$

Taking the derivative wrt m

$$\begin{aligned} \frac{\partial Z(\theta_i, m)}{\partial m} &= \theta_D m_0^{-1}(m)[G'(m-m_D)G(m_A-s) - G(m-m_D)G'(m_A-m)] \\ &+ \frac{1-F(m_0^{-1}(m))}{f(m_0^{-1}(m))} m_0^{-1}(m) 2G(m_A-m)G'(m_A-m) - \theta_i^2 G(m_A-m)G'(m_A-m) \\ &= 0 \text{ if } m = m_0(\theta_i) \end{aligned}$$

where $m_0(\theta_i)$ is the mission rule that satisfies the FOCs in (12). Thus, I have shown that the optimal mission is implemented by the modified scoring rule $S^*(m,p)$. Since under the first and second-score auction with scoring rule $S^*(m,p)$, both the allocation rule and the project mission are the same as under the optimal mechanism, the first-and second-score auctions with this optimal scoring rule give the same expected utility to the principal than the optimal mechanism.

Proof of Proposition 3

I now show that the optimal mechanism when the project mission must be fixed ex-ante can be implemented through a second-price auction (with or without ceiling price). In a second price auction the principal's expected utility from a bidder with intrinsic motivation $\theta_i \geq \underline{\theta}$ is

$$\begin{aligned} E(V_D) &= \theta_D \theta_i G(m-m_D)G(m_A-m)F(\theta_i)^{n-1} + \frac{G(m_A-m)^2}{2}\underline{\theta}^2 F(\underline{\theta})^{n-1} \\ &+ \int_{\underline{\theta}}^{\theta_i} \frac{G(m_A-m)^2}{2} x^2 (n-1)F(x)^{n-2} f(x)dx \end{aligned}$$

So the principal's *overall* expected utility is

$$\begin{aligned} E(V_D) &= \theta_D G(m-m_D)G(m_A-m)(1-F_1(\underline{\theta}))E(Y_1/Y_1 > \underline{\theta}) + \frac{G(m_A-m)^2}{2}\underline{\theta}^2 nF(\underline{\theta})^{n-1}(1-F(\underline{\theta})) \\ &+ \tfrac{1}{2}G(m_A-m)^2(1-F_2(\underline{\theta}))E(Y_2^2/Y_2 > \underline{\theta}) \end{aligned}$$

Taking the derivative of $E(V_D)$ with respect to $\underline{\theta}$ and rearranging gives

$$2\frac{1-F(\underline{\theta})}{f(\underline{\theta})} - 2\frac{\theta_D G(m-m_D)}{G(m_A-m)} - \underline{\theta} \leq 0 \tag{A-6}$$

If the expression above is negative $\forall\ \underline{\theta}$, then the second price auction should not have a ceiling price and the optimal mission satisfies the FOC in equation (20). If the expression above can hold with equality, the second price auction should have a ceiling price $p(\underline{\theta})$ and optimal mission m, where m and $\underline{\theta}$ solve the following system of equations

$$2\frac{1-F(\underline{\theta})}{f(\underline{\theta})} - 2\frac{\theta_D G(m-m_D)}{G(m_A-m)} - \underline{\theta} = 0 \tag{A-7}$$

$$\frac{(1-F_2(\underline{\theta}))E(Y_2^2|Y_2>\underline{\theta}) + \underline{\theta}^2 F(\underline{\theta})^{n-1}(1-F(\underline{\theta}))n}{(1-F_1(\underline{\theta}))E(Y_1|Y_1>\underline{\theta})\theta_D} - \frac{G'(m-m_D)}{G'(m_A-m)} + \frac{G(m-m_D)}{G(m_A-m)} = 0 \tag{A-8}$$

where $F_1(.)$ and $F_2(.)$ are, respectively, the distribution function of the first and second highest order statistic of n independently drawn θ. So under the second price auction with ceiling price $p(\underline{\theta})$, the optimal allocation rule is

$$q_i^{SP}(\theta) = \begin{cases} 1 & \text{if } \theta_i > \max_{\forall j \neq i} \theta_j \text{ and } \theta_i > \underline{\theta}^{SP} \\ 0 & \text{otherwise} \end{cases}$$

Following the same steps as in the proof of Proposition 1, the principal's utility under the optimal mechanism can be rewritten as

$$\begin{aligned} E(V_D) &= \sum_{i=1}^{n} E_\theta\Big(q_i(\theta)\Big(\theta_D\theta_i G(m-m_D)G(m_A-m) + \frac{\theta_i^2}{2}G(m_A-m)^2 \\ &\quad - \frac{1-F(\theta_i)}{f(\theta_i)}\theta_i G(m_A-m)^2\Big)\Big) f(\theta)d\theta \end{aligned}$$

The virtual valuations in the expression above are positive for those agents whose θ_i satisfies

$$2\frac{1-F(\theta_i)}{f(\theta_i)} - 2\frac{\theta_D G(m^*-m_D)}{G(m_A-m^*)} - \theta_i \leq 0$$

Notice that the expression above coincides with inequality (A-6). Furthermore, for those θ_i that satisfies this equation, it can be check that the virtual valuations are increasing in θ_i. This means that the allocation rule under the optimal mechanism is the same as under the second price auction: $q_i^*(\theta) = q_i^{SP}(\theta)$. This in turn implies that the expected utility of the principal under the second price auction is the same as under the optimal mechanism, and therefore so is the optimally chosen mission.

Finally, notice that by the Revenue Equivalence Theorem, the optimal mechanism can also be implemented through any (reverse) auction in the wide class of auctions that allocate the price to the lowest bidder, namely, first-price auction, all-pay auction, and so on. Indeed, since such auctions have the same allocation rule and yield the same expected payment to the seller, the optimal project mission chosen ex-ante will also be the same.

Proof of Proposition 4

a) For any distribution function $F(.)$ over the interval $[0,1]$, it holds that

$$\lim_{n\to\infty} \frac{E[Y_2^2]}{E[Y_1]} \geq \lim_{n\to\infty} E[Y_2] = 1$$

This gives us a lower bound for when competition is high. Furthermore, since:

$$E[Y_2^2] \leq E[Y_2.1] = E[Y_2] \leq E[Y_1]$$

it follows that $E[Y_2^2]/E[Y_1] \leq 1$ for any finite n.

b) Consider any distribution function $F(.)$ over the interval $[0,1]$. Then, a *sufficient* but not necessary condition for $dm^*/dn > 0$ is $dE[Y_1]/dn - dE[Y_2^2]/dn < 0$. After few mathematical steps you get

$$S = E[Y_1] - E[Y_2^2] \quad = \quad \int_0^1 nF(x)^{n-1}2x - F(x)^n(1 + 2x(n-1))dx$$

Taking the derivative with respect to n gives and rearranging gives

$$\frac{dS}{dn} \quad = \quad \int_0^1 F(x)^{n-1}\{2x(1-F(x))(1 + log[F(x)]n) + log[F(x)]F(x)(2x-1)\}dx$$

The overall sign of the expression above depends on the sign of the expression in the curly brackets. The last term is independent of n while the first term gets more negative as n increases. So there must exists a value of n, which I define n_0, such that for any $n \geq n_0$ the expression above is negative. Therefore, $dm^*/dn > 0$ for any $n \geq n_0$.

c) I now show that for the uniform and any power function distributions, $E[Y_2^2]/E[Y_1]$ is strictly increasing in n. If $F(.)$ is uniformly distributed, $E[Y_2^2] = (n-1)n/(n+1)(n+2)$, and $E[Y_1] = n/(n+1)$. This gives $E[Y_2^2]/E[Y_1] = (n-1)/(n+2)$ which is strictly increasing in n.

Let's take any power function distribution $F(\theta) = \theta^a$:

$$\frac{E[Y_2^2]}{E[Y_1]} = \frac{a(n-1)(1+an)}{(2+a(n-1))(2+an)}$$

Taking the first derivative with respect to n and simplifying gives:

$$\frac{dS}{dn} = \frac{2(a-1)}{(2+a(n-1))^2} + \frac{2+a}{(2+an)^2}$$

The expression above is clearly positive for $a \geq 1$. For $a < 1$

$$\frac{2+a}{(2+an)^2} > \frac{2(1-a)}{(2+a(n-1))^2}$$

After few algebraic steps we get

$$a^3((n-1)^2+n^2)+2a^2(2n-1)>0$$

which always holds for any $n \geq 2$.

Proof of Proposition 5

Let's define the expected value of the LHS of equation (12) as

$$R = \int_0^1 \Big(\theta_i - 2\frac{1-F(\theta_i)}{f(\theta_i)}\Big) f_1(\theta_i) d\theta_i$$

where $f_1(.)$ is the density function of the first order statistic of n independently drawn θ. To prove that the expected agent's ideological compromise is lower under the optimal mechanism with ex-ante fixed mission than under the optimal scoring auction, I need to show that $R(\theta) < E[Y_2^2]/E[Y_1]$. Let's start by rewriting

$$R = E[Y_1] - 2n(E[Y_1] - E[Y_1^{(n-1)}])$$

where $E[Y_1^{(n-1)}]$ is the expected value of the first order statistics of $(n-1)$ independent drawn values of θ. Notice that

$$2nE[Y_1^{(n-1)}] = 2(E[Y_2] + (n-1)E[Y_1])$$

which, after few algebraic steps, gives

$$R = 2E[Y_2] - E[Y_1]$$

Thus, it is sufficient to show that

$$2E[Y_2] - E[Y_1] < \frac{E[Y_2^2]}{E[Y_1]}$$

which then leads to

$$-(E[Y_1]-E[Y_2])^2 < E[Y_2^2] - E[Y_2]^2$$

The equation above always holds as the LHS is negative and the RHS is positive. Since

$$\frac{(1-F_2(\underline{\theta}))E(Y_2^2|Y_2>\underline{\theta}) + \underline{\theta}^2 F(\underline{\theta})^{n-1}(1-F(\underline{\theta}))n}{(1-F_1(\underline{\theta}))E(Y_1|Y_1>\underline{\theta})} \geq \frac{E[Y_2^2]}{E[Y_1]}$$

I have shown that under the optimal price-only competition (with or without exclusion), the agent's expected ideological compromise is lower than under the optimal scoring auction.

Proof of Proposition 6

I restrict my attention to contracts in which $m(\theta)$ is continuous. This implies that for the contracts to be incentive compatible $p(\theta)$ must also be continuous.[3] The overall proof is made up of several Lemmas.

Lemma 1 *Under a direct and truthful mechanism, there cannot be more than one type that exerts his optimal -unconstrained- level of effort and for which the budget constraint binds, i.e.* $p(\theta) = \frac{1}{2}\theta^2 G(m_A - m(\theta))^2$.

PROOF[by contradiction]: Consider type $(\theta-\epsilon)$ and type θ, for which the budget constraints are binding, namely $p(\theta) = \frac{1}{2}\theta^2 G(m_A - m(\theta))^2$ and $p(\theta-\epsilon) = \frac{1}{2}(\theta-\epsilon)^2 G(m_A - m(\theta-\epsilon))^2$. Notice that type θ would be budget constrained under the contract of type $(\theta-\epsilon)$, whereas the latter would exert his optimal level of effort under the contract of type θ. Under a direct and truthful mechanism the following two conditions must hold:

$$\theta^2 G(m_A - m(\theta))^2 \geq \theta(\theta-\epsilon) G(m_A - m(\theta-\epsilon))^2 \tag{A-9}$$

$$(\theta-\epsilon)^2 G(m_A - m(\theta-\epsilon))^2 \geq \tfrac{1}{2}(\theta^2 + (\theta-\epsilon)^2) G(m_A - m(\theta))^2 \tag{A-10}$$

where (A-9) refers to the incentive compatibility constraint for type θ (agent θ gets higher utility by reporting his true type than by reporting type $(\theta-\epsilon)$) and (A-10) refers to the incentive compatibility constraint for type $(\theta-\epsilon)$ (agent $(\theta-\epsilon)$ gets higher utility by reporting his true type than by reporting type θ). Rearranging (A-9) and (A-10) gives respectively:

$$\frac{\theta}{\theta-\epsilon} \geq \frac{G(m_A - m(\theta-\epsilon))^2}{G(m_A - m(\theta))^2}$$

$$\frac{G(m_A - m(\theta-\epsilon))^2}{G(m_A - m(\theta))^2} \geq \frac{\theta^2 + (\theta-\epsilon)^2}{2(\theta-\epsilon)^2}$$

These two conditions cannot be simultaneously satisfied since $\frac{\theta^2+(\theta-\epsilon)^2}{2(\theta-\epsilon)^2} > \frac{\theta}{\theta-\epsilon}$:

$$\Leftrightarrow \frac{\theta^2 + (\theta-\epsilon)^2}{2(\theta-\epsilon)} > \theta$$

$$\Leftrightarrow \theta^2 + (\theta-\epsilon)^2 > 2\theta(\theta-\epsilon)$$

$$\Leftrightarrow (\theta - (\theta-\epsilon))^2 > 0$$

$$\Leftrightarrow \epsilon^2 > 0$$

which is true for any $\epsilon \neq 0$. This proves Lemma 1.

Corollary 1 *There can be only one interval in which the agent is budget constrained under a direct and truthful mechanism, and this interval must include the highest type,* $\theta = 1$.

[3] Suppose that the optimal mechanism involves a downward (upward) jump in $p(.)$ at the point $\theta = \tilde{\theta}$ while $m(.)$ is continuous in that point. Then, the contract $(m(\tilde{\theta}+\epsilon), p(\tilde{\theta}+\epsilon))$ with $\epsilon \to 0$ is less (more) attractive than the contract $(m(\tilde{\theta}-\epsilon), p(\tilde{\theta}-\epsilon))$ for all types, which implies that the incentive compatibility constraint is violated.

PROOF: By the continuity assumption on $m(\theta)$, $p(\theta)$ and $g(m(\theta),\theta)=\frac{1}{2}\theta^2G(m_A-m(\theta))^2$ must also be continuous in θ. Therefore, if agents of type $\theta\in[\underline{\theta},\overline{\theta}]\subset(0,1)$ are budget constrained under a direct and truthful mechanism, then it must be true that $p(\underline{\theta})=g(m,\underline{\theta})$ and that $p(\overline{\theta})=g(m,\overline{\theta})$. However, Lemma 1 shows that under any implementable mechanism there can't be more than one type that exerts his optimal -unconstrained- level of effort and for which the budget constraint is binding. Therefore under the direct and truthful mechanism there can't be an interval $[\underline{\theta},\overline{\theta}]\subset(0,1)$ such that all types in that interval are budget constrained. Finally, notice that type $\theta=0$ cannot be budget constrained since his optimal level of effort is equal to zero. Corollary 1 then follows: under a direct and truthful mechanism the only interval of types for which the budget constraints can be binding is of the form: $[\overline{\theta},1]$. It also implies that $p(\overline{\theta})=\frac{1}{2}\overline{\theta}^2G(m_A-m(\overline{\theta}))^2$.

So we are left with three possible cases: $\overline{\theta}=1$, i.e. no agent is budget constrained; $\overline{\theta}\to 0$, i.e. all agents are budget constrained; and $\overline{\theta}\in(0,1)$, i.e. types in $[0,\overline{\theta}]$ exert their optimal -unconstrained- level of effort, while types in $[\overline{\theta},1]$ are budget constrained. I will now analyze each of these cases separately.

<u>Case 1</u>: $\overline{\theta}=1$

We are in the case in which all types in the interval $[0,1]$ exert their optimal -unconstrained- level of effort. Together with Lemma 1, this implies that the budget constraint is binding for the highest type, i.e. $p(1)=\frac{1}{2}G(m_A-m(1))^2$, and is slack for all remaining types, i.e. $p(\theta)>\frac{1}{2}\theta^2G(m_A-m(\theta))^2\ \forall\ \theta\in[0,1)$.

Lemma 2 *If all types in the interval* $[0,1]$ *exert their optimal -unconstrained- level of effort under a direct and truthful mechanism, then* $m(\theta)$ *must be non-decreasing in that interval.*

To prove Lemma 2 I first need the following step:

Step 1 *The agent always exerts his optimal -unconstrained- level of effort under deviation* $\Longleftrightarrow$ $m(\theta)$ *is non-decreasing.*

PROOF: If the agent is never budget constrained under deviation, he exerts effort $e=\theta_iG(m_A-m(z))$ for all z, the latter being the reported type. Thus, the incentive compatibility constraint can be written as follows:

$$U(\theta)=\max_{z\in\Theta}\{p(z)+\tfrac{1}{2}\theta^2G(m_A-m(z))^2\}$$

Remind that we defined $g(m,\theta)=\frac{1}{2}\theta^2G(m_A-m)^2$. Then:

$$\frac{\partial g(m,\theta)}{\partial m\partial\theta}=2\theta G(m_A-m)G'(m_A-m)(-1)>0$$

which implies that $g(m,\theta)$ has strict single crossing differences in (m,θ). By the Monotonic Selection Theorem we then know that $m(\theta)$ must be non-decreasing. This proves the right direction of the relationship in Step 1. Now suppose that under the direct and truthful mechanism $m(\theta)$ is increasing in the interval $[0,1]$. For the incentive compatibility constraint to be satisfied, $p(\theta)$ must be decreasing in that interval since the agent's utility is increasing in both $m(\theta)$ and $p(\theta)$. Now, if agent θ deviates downwards, he gets a lower level of discretion and a higher payment, so if he is not budget constrained by reporting his true type, he won't be budget constrained by reporting a lower type. If agent θ deviates upwards, he gets more discretion and a lower payment. However, since by assumption type $(\theta+\epsilon)$ is not budget constrained by reporting his true type, neither will be type θ by reporting $(\theta+\epsilon)$. This proves the left direction of the relationship in Step 1.

With step 1 in mind, I can now proceed with proof of Lemma 2:

PROOF[by contradiction]: Suppose that under the direct and truthful mechanism $m(\theta)$ is decreasing in $[0,1]$. Then, it is always possible to construct an interval $[\theta-\epsilon, \theta+\epsilon] \subset [0,1]$ in which the agent would exert his optimal - unconstrained- level effort under deviations in that interval. If $m(\theta)$ is decreasing, by reporting type $z=(\theta+\epsilon)$ rather than his true type, agent θ would get a higher payment and less discretion, so he would not be budget constrained. As far as deviations downwards are concerned, let's first remind that by Lemma 1 the budget constraints must be slack for all types $[0,1)$. Therefore, by the continuity assumption above, there must always exist an ϵ small enough such that

$$p(\theta) > p(\theta-\epsilon) \geq \tfrac{1}{2}\theta^2 G(m_A - m(\theta-\epsilon))^2 > \tfrac{1}{2}\theta^2 G(m_A - m(\theta))^2$$

which means that under the contract for type $(\theta-\epsilon)$, agent θ exerts his optimal level of effort. From step 1 we know that $m(\theta)$ must be non-decreasing in the interval $[\theta-\epsilon, \theta+\epsilon]$, which contradicts the initial assumption of $m(\theta)$ being decreasing in $[0,1]$. This proves Lemma 2.

Lemma 3 *There is always a pooling contract that gives the principal a higher utility than a (full or partial) separating contract under which all types exert their optimal - unconstrained- level of effort.*

PROOF: Suppose there is a contract $(m^s(\theta), p^s(\theta))$ that (fully or partially) separates on the entire interval of types, $[0,1]$, and under which any agent is exerting his optimal - unconstrained- level of effort. From Lemma 2 we know that for such contract to be implementable, $m^s(\theta)$ must be non-decreasing in $[0,1]$, which in turn implies that $p^s(\theta)$ must be non-increasing. Therefore, the following inequalities must hold:

$$m^s(1) \geq m^s(\theta) \ \forall \ \theta \tag{A-11}$$

$$p^s(\theta) \geq p^s(1) = \tfrac{1}{2}G(m_A - m^s(1))^2 \ \forall \ \theta \tag{A-12}$$

I will now show that the principal gets a higher utility by offering the following pooling contract to all types :

$$m^p = \min\{m^s(1), \tilde{m}\} \tag{A-13}$$

$$p^p = \min\{\tfrac{1}{2}G(m_A - m^s(1))^2, \tfrac{1}{2}G(m_A - \tilde{m})^2\} \tag{A-14}$$

where $\tilde{m} = arg\ max_m\ Y(\theta, m) = \theta\theta_D G(m - m_D)G(m_A - m)$. In other words, $\tilde{m}$ is the mission that maximizes the utility that the principal gets from the project's output if the agent exerts his optimal -unconstrained- level of effort. Notice that $\tilde{m}$ does not depend on θ. Recall that the principal's expected utility from allocating the contract to an agent of type θ is $E(V_D) = \int_0^1 (Y(\theta, m) - p(\theta))f(\theta)d\theta$.

Suppose $m^s(1) < \tilde{m}$. This means that, everything else being equal, the principal could increase his utility by increasing the level of discretion of all agents. More specifically, by offering a contract with mission $m^p = m^s(1)$ and payment $p^p = \frac{1}{2}G(m_A - m^s(1))^2$ to all types, the latter would still exert their optimal - unconstrained - level of effort, so the principal would not only increase $Y(\theta, m)$ for all types but, by (A-12), he would also decrease $p(\theta)$ for all types. Therefore, under that pooling contract principal's utility will be unambiguously higher than under any implementable (full or partial) separating contract $(m^s(\theta), p^s(\theta))$.

Suppose now that $m^s(1) > \tilde{m}$. Then, everything else being equal, the principal could increase his utility by increasing the level of discretion of those types for which $m^s(\theta) < \tilde{m}$ and by decreasing the level of discretion of those types for which $m^s(\theta) > \tilde{m}$. More specifically, by offering a contract with mission $m^p = \tilde{m}$ and payment $p^p = \frac{1}{2}G(m_A - \tilde{m})^2$ to all types, the latter would still exert their optimal -unconstrained- level of effort, so the principal would not only increase $Y(\theta, m)$ for all types, but by equation (A-12) and the fact that $m^s(1) > \tilde{m}$, he would also decrease $p(\theta)$ for all types. Therefore, under that pooling contract principal's utility will be unambiguously higher than under any implementable (full or partial) separating contract $(m^s(\theta), p^s(\theta))$. This proves Lemma 3. We now turn to the case in which all types are budget constrained.

<u>Case 2</u>: $\overline{\theta} \to 0$

The maximization problem faced by the principal when all types are budget constrained is

$$\max_{m,p} \ V_D = \theta_D G(m(\theta) - m_D)\sqrt{2p(\theta)} - p(\theta)$$
$$\text{s.t. } p(\theta) < \tfrac{1}{2}G(m_A - m(\theta))^2 \ \forall\theta$$

Note that it does not depend directly on θ. The solution to the unconstrained problem is to offer the pooling contract $(m_D, p = \frac{1}{2}\theta_D^2 G(0)^2)$ to all types. However, for this solution to be feasible it must satisfy the inequality constraints $p(\theta) < \frac{1}{2}G(m_A - m(\theta))^2 \ \forall \ \theta$. In other words, it must be true that

$$e = \min\{\theta G(m_A - m_D), \theta_D G(0)\} = \theta_D G(0) \quad \forall\theta \in [0, 1]$$

This condition never holds for any $\theta < \theta_D$. Therefore, under the optimal mechanism there must be some types who exert their optimal -unconstrained- level of effort. We now look at that last case.

<u>Case 3</u>: $\overline{\theta} \in (0, 1)$

Suppose types in the interval $[0, \overline{\theta}]$ exert their optimal -unconstrained- level of effort, while types in the interval $[\overline{\theta}, 1]$ are budget constrained. The budget constraint binds for type $\overline{\theta}$, i.e. $p(\overline{\theta}) = \frac{1}{2}\overline{\theta}^2 G(m_A - m(\overline{\theta}))^2$. This part of the proof is divided in two Lemmas. In the first Lemma I prove that there exists no incentive compatible mechanism with decreasing $m(\theta)$, in the second Lemma I prove that there always exists a pooling contract that outperforms a separating mechanism with increasing $m(\theta)$.

Lemma 4 *There exists no implementable mechanism in which $m(\theta)$ is (partly or fully) decreasing in the interval of types who are budget constrained.*

PROOF: From Lemma 2 we know that under any direct and truthful mechanism $m(\theta)$ must be non-decreasing in the interval $[0, \overline{\theta}]$. Now suppose that $m(\theta)$ is partly or fully decreasing in the interval $[\overline{\theta}, 1]$. This implies that $m(\theta)$ must be -strictly- increasing in the interval $[0, \overline{\theta}]$. Indeed, notice that $p(\theta)$ must reach a global maximum at $\theta = 0$ - and therefore $m(\theta)$ must reach a global minimum at $\theta = 0$ - otherwise type 0 who does not care about any mission would deviate to the contract with the highest payment.

Now suppose that $m(\theta)$ is increasing in the interval $[\overline{\theta}, \hat{\theta}]$ and decreasing in the interval $[\hat{\theta}, \check{\theta}]$, with $\overline{\theta} < \hat{\theta} < \check{\theta} \leq 1$. It follows that the function $m(\theta)$ reaches a local maximum at $\theta = \hat{\theta}$. Thus, some types below $\hat{\theta}$ must receive the same contract as some types above $\hat{\theta}$. Suppose type $(\hat{\theta} - \epsilon)$ receives the same contract, $(\tilde{m}, \tilde{p})$, as type $(\hat{\theta} + y)$, where $\epsilon, y > 0$, and $(\hat{\theta} - \epsilon) > \overline{\theta}$. On the other hand, type $\hat{\theta}$ receives the contract $(\hat{m}, \hat{p})$. The utility of agent $\hat{\theta}$ when reporting is truth type is

$$U(\hat{\theta}, \hat{\theta}) = \hat{\theta} G(m_A - \hat{m}) \sqrt{2\hat{p}}$$

Whereas his utility when reporting type $(\hat{\theta} - \epsilon)$ is

$$U(\hat{\theta}, \hat{\theta} - \epsilon) = \hat{\theta} G(m_A - \tilde{m}) \sqrt{2\tilde{p}}$$

Indeed, if type $(\hat{\theta} - \epsilon)$ is budget constrained under contract $(\tilde{m}, \tilde{p})$, so will be type $\hat{\theta}$. For the incentive compatibility constraint to hold, it must be true that $U(\hat{\theta}, \hat{\theta}) \geq U(\hat{\theta}, \hat{\theta} - \epsilon)$, i.e. $G(m_A - \hat{m}) \sqrt{2\hat{p}} \geq G(m_A - \tilde{m}) \sqrt{2\tilde{p}}$. Similarly, the utility of agent $(\hat{\theta} + y)$ when revealing his true type is

$$U(\hat{\theta} + y, \hat{\theta} + y) = (\hat{\theta} + y) G(m_A - \tilde{m}) \sqrt{2\tilde{p}}$$

Whereas his utility when reporting type $\hat{\theta}$ is

$$U(\hat{\theta} + y, \hat{\theta}) = (\hat{\theta} + y) G(m_A - \hat{m}) \sqrt{2\hat{p}}$$

Under a direct and incentive compatible mechanism it must hold that $U(\hat{\theta} + y, \hat{\theta} + y) \geq U(\hat{\theta} + y, \hat{\theta})$, i.e. $G(m_A - \tilde{m}) \sqrt{2\tilde{p}} \geq G(m_A - \hat{m}) \sqrt{2\hat{p}}$. This is a contradiction with what I found above. The incentive compatibility constraints of type $\hat{\theta}$ and of type $\hat{\theta} + y$ cannot be simultaneously satisfied unless contract $(\tilde{m}, \tilde{p})$ is equal to contract $(\hat{m}, \hat{p})$. This is true for any $\hat{\theta} - \epsilon > \overline{\theta}$, any $\hat{\theta} + y$, and any $\check{\theta}$.

I am now left to check what happens when $m(\theta)$ starts decreasing at $\theta = \overline{\theta}$. This implies that $m(\theta)$ reaches a local maximum at $\theta = \overline{\theta}$. It follows that each type in the interval $[\overline{\theta}, 1]$ is offered the same contract as a lower type $\theta < \overline{\theta}$ who is not budget constrained. Indeed if this was not the case, there would be contracts with same missions but different payments, so this mechanism would not be incentive compatible. It follows that each contract offered to types that are budget constrained, namely to $\theta \in [\overline{\theta}, 1]$, must also satisfy the incentive compatibility constraint of a type that exerts his optimal - unconstrained- level of effort, $\theta \in [0, \overline{\theta}]$. I will now show that this is not possible. More specifically, I will show that under such mechanism, types $(\overline{\theta}, 1]$ have an incentive to deviate to the contract of type $\overline{\theta}$.

Suppose, for instance, that type $(\overline{\theta}+\epsilon)$ with $\epsilon>0$ is offered the same contract as type $\hat{\theta}\in[0,\overline{\theta})$, which we define as $(\hat{m},\hat{p})$. As stated above, this contract must satisfy the incentive compatibility constraint of type $\hat{\theta}$. Since $m^s(\theta)$ is increasing in $[0,\overline{\theta}]$, agent $\hat{\theta}$ exerts his optimal -unconstrained- level of effort under his contract and, by Step 1, also under any deviation in $[0,\overline{\theta}]$. More generally, I can write the incentive compatibility constraint of type $\theta\in[0,\overline{\theta}]$ as follows:

$$U(\theta)=\max_{z\in[0,\overline{\theta}]}\{p(z)+\tfrac{1}{2}\theta^2G(m_A-m(z))^2\}$$

Applying the envelope theorem, the next steps are standard:

$$U'(\theta)=\theta G(m_A-m(\theta))^2$$

$$U(\theta)=U(0)+\int_0^\theta tG(m_A-m(t))^2dt$$

From there we can easily pin down $\hat{p}$ as a function of $\hat{m}$:

$$\hat{p}=p(\hat{m})=p(0)-\tfrac{1}{2}\hat{\theta}^2G(m_A-\hat{m})^2+\int_0^{\hat{\theta}} tG(m_A-m(t))^2dt \tag{A-15}$$

where $\hat{\theta}=m^{-1}(\hat{m})$, so $\hat{\theta}$ is a function of $\hat{m}$. Therefore, we can write down the utility of type $(\overline{\theta}+\epsilon)$ when he reports his type truthfully, as a function of $\hat{m}$:

$$U(\overline{\theta}+\epsilon,\hat{m})=(\overline{\theta}+\epsilon)G(m_A-\hat{m})\sqrt{2p(\hat{m})} \tag{A-16}$$

Now, it is important to notice that if type $(\overline{\theta}+\epsilon)$ does not report his type truthfully but deviates downwards, he will still remain budget constrained. Indeed, if type $(\overline{\theta}+\epsilon-y)$, with $\epsilon-y\geq 0$, is budget constrained under his own contract $(\check{m},\check{p})$[4], so will be type $(\overline{\theta}+\epsilon)$ under that same contract. This means that the utility of type $(\overline{\theta}+\epsilon)$ by reporting type $(\overline{\theta}+\epsilon-y)$ will be

$$U(\overline{\theta}+\epsilon,\check{m})=(\overline{\theta}+\epsilon)G(m_A-\check{m})\sqrt{2p(\check{m})} \tag{A-17}$$

A sufficient condition for this mechanism not to be incentive compatible is $U(\overline{\theta}+\epsilon,\check{m})>U(\overline{\theta}+\epsilon,\hat{m})$ for all $\epsilon>0$. Since $\check{m}>\hat{m}$, this is true if and only if $U(\overline{\theta}+\epsilon,\hat{m})$ is strictly increasing in $\hat{m}$ for all ϵ. I will now show that this is indeed the case.

Let's first calculate:

$$\frac{dp(\hat{m})}{d\hat{m}}=\frac{\partial p}{\partial\hat{\theta}}\hat{\theta}'(\hat{m})+\frac{\partial p}{\partial\hat{m}} \tag{A-18}$$

Notice that $\frac{\partial p}{\partial\hat{\theta}}=0$, so the expression above simplifies to

$$\frac{dp(\hat{m})}{d\hat{m}}=-\hat{\theta}^2G(m_A-\hat{m})G'(m_A-\hat{m})(-1)$$

Using the product rule we then get:

$$\frac{\partial U(\overline{\theta}+\epsilon,\hat{m})}{\partial\hat{m}}=\Big(\overline{\theta}+\epsilon\Big)\Big(G'(m_A-\hat{m})(-1)\sqrt{2\hat{p}}-\frac{G(m_A-\hat{m})}{\sqrt{2\hat{p}}}\hat{\theta}^2G(m_A-\hat{m})G'(m_A-\hat{m})(-1)\Big)$$

[4]It is important to remind that all types in the interval $(\overline{\theta},1]$ receive the same contract as a lower type in the interval $[0,\overline{\theta})$. Therefore, also the contract $(\check{m},\check{p})$ must satisfy equation (A-15)

Rearranging the expression above we get:

$$\frac{\partial U(\overline{\theta}+\epsilon,\hat{m})}{\partial \hat{m}} = \Big(\overline{\theta}+\epsilon\Big)\Big(G'(m_A-\hat{m})(-1)\Big(\sqrt{2\hat{p}}-\frac{\hat{\theta}^2 G(m_A-\hat{m})^2}{\sqrt{2\hat{p}}}\Big)\Big) \tag{A-19}$$

whose sign depends on the term $\Big(\sqrt{2\hat{p}}-\frac{\hat{\theta}^2 G(m_A-\hat{m})^2}{\sqrt{2\hat{p}}}\Big)$. Since $\hat{\theta}\in[0,\overline{\theta})$ then it must be true that $\sqrt{2\hat{p}}>\hat{\theta}G(m_A-\hat{m})$. This implies that the sign of $\Big(\sqrt{2\hat{p}}-\frac{\hat{\theta}^2 G(m_A-\hat{m})^2}{\sqrt{2\hat{p}}}\Big)$ is positive, and so is the sign of (A-19). This holds for any pairs $\hat{\theta}$ and $\epsilon>0$. So we conclude that types $\theta\in(\overline{\theta},1]$ want to deviate to the contract with the highest m, that is, to the contract of type $\overline{\theta}$. Therefore, a mechanism with decreasing $m(\theta)$ in the interval $[\overline{\theta},1]$ is never incentive compatible. This proves Lemma 4.

I now look at the case with increasing $m(\theta)$.

Lemma 5 *There is always a pooling contract that gives the principal a higher utility than any (partial or full) separating contract with non-decreasing $m(\theta)$ and binding budget constraints for types $[\overline{\theta},1]$.*

To prove Lemma 5 we first need the following step:

Step 2 *Under the optimal mechanism, the utility that the principal gets from contracting with the highest type must be at least as large as the utility he gets from contracting with any lower type, i.e. $V_D(1,m(1),p(1))\geq V_D(\theta,m(\theta),p(\theta))\ \forall\ \theta<1$.*

PROOF[by contradiction]: Suppose that under the optimal mechanism agent $\hat{\theta}$ receives the contract $(m(\hat{\theta}),p(\hat{\theta}))$, which gives the principal an utility equal to $V_D(\hat{\theta},m(\hat{\theta}),p(\hat{\theta}))$. It is then straightforward to verify that by offering this same contract to a higher type, the principal gets at least this same level of utility, namely $V_D(\theta,m(\hat{\theta}),p(\hat{\theta}))\geq V_D(\hat{\theta},m(\hat{\theta}),p(\hat{\theta}))\ \forall\ \theta>\hat{\theta}$. It follows that the principal can always improve upon a mechanism in which his utility is highest at $\theta=\hat{\theta}$ by offering the same contract offered to $\hat{\theta}$ to all $\theta\in(\hat{\theta},1]$. This holds for any $\hat{\theta}<1$. Therefore under the optimal mechanism, the contact offered to type 1 must generate to the principal at least the same level of utility as any other contract offered to a lower type.

With step 2 in mind, we now proceed with proving Lemma 5.

PROOF: Suppose there is an original contract $(m^s(\theta),p^s(\theta))$ that separates over the full interval of types and that the budget constraints bind in the interval $[\overline{\theta},1]$. From Lemma 2 we know that under any incentive compatible separating mechanism, $m^s(.)$ must be increasing in the interval $[0,\overline{\theta}]$. So now suppose that $m^s(.)$ is also increasing in the interval $[\overline{\theta},1]$, such that $m^s(.)$ is increasing and $p^s(.)$ is decreasing in the entire interval of types. From Step 2 we know that since the contract is separating on the interval $[\overline{\theta},1]$:

$$V_D^{fc}(m^s(1),p^s(1))\geq V_D^{fc}(m^s(\theta),p^s(\theta))\ \ \forall\ \ \theta\in[\overline{\theta},1)$$

where $V_D^{fc}(m^s(\theta),p^s(\theta))$ is the utility that the principal gets from agent θ when the latter is budget constrained under his contract. Similarly, we define by $V_D^{nfc}(\theta,m^s(\theta),p^s(\theta))$ the utility that the principal gets from agent θ when the latter exerts his optimal -unconstrained - level of effort under his contract. There can be three scenarios: $\tilde{m} > m^s(1) > m^s(\overline{\theta})$, $m^s(1) > m^s(\overline{\theta}) > \tilde{m}$, and $m^s(1) > \tilde{m} > m^s(\overline{\theta})$, where $\tilde{m}$ is defined as before, namely $\tilde{m} = arg\ max_m\ Y(\theta, m) = \theta\theta_D G(m - m_D)G(m_A - m)$.

Suppose $\tilde{m} > m^s(1) > m^s(\overline{\theta})$. I will now show that the principal is better off by offering the pooling contract $(m^s(1), p^s(1))$ to all types. Assume he does so. Under the contract $(m^s(1), p^s(1))$, types in the interval $[\overline{\theta}, 1]$ are still budget constrained since they get more discretion and a lower payment than in the original contract. Therefore, they generate utility for the principal equal to $V_D^{fc}(m^s(1), p^s(1))$. From step 2, we then know that principal's utility from these types has increased with respect to the original contract. Let's now look at the interval $[0, \overline{\theta}]$. Let's define by $\hat{\theta}$ the lowest type for which the budget constraint binds under the contract $(m^s(1), p^s(1))$. Then, types $[0, \hat{\theta}]$ exert their optimal level of effort as under the original contract. From Lemma 3 we know that principal's utility has increased with respect to the original contract for types in that interval. Finally, let's look at the interval $[\hat{\theta}, \overline{\theta}]$. These types are budget constrained under the contract $(m^s(1), p^s(1))$. Therefore, they generate utility for the principal equal to $V_D^{fc}(m^s(1), p^s(1))$. From Step 2, we then know that principal's utility from these types has increased with respect to any original contract. This proves that the principal is better off by offering the pooling contract $(m^s(1), p^s(1))$ than the original separating contract.

Suppose now that $m^s(1) > m^s(\overline{\theta}) > \tilde{m}$. I will show that in this case the principal is better off by offering the pooling contract $(\tilde{m}, p^s(1))$ to all types. Let's define by $\hat{\theta}$ the lowest type that is budget constrained under that contract. Assume $\hat{\theta} > \overline{\theta}$. Then, for all $\theta \in [\hat{\theta}, 1]$, the pooling contract $(\tilde{m}, p^s(1))$ yields a higher utility to the principal than the original separating contract, $\tilde{m}$ being lower than $m^s(1)$:

$$V_D^{fc}(\tilde{m}, p^s(1)) = \theta_D G(\tilde{m} - m_D)\sqrt{2p^s(1)} - p^s(1) > V_D^{fc}(m^s(1), p^s(1)) \tag{A-20}$$

For all $\theta \in [0, \overline{\theta}]$, who exert their optimal level of effort under both contracts, the pooling contract also yields a higher utility to the principal as $\tilde{m}$ maximizes $Y(\theta, m)$ and $p^s(1) < p^s(\theta)$ $\forall\ \theta$. Finally, let's consider types in the the interval $[\overline{\theta}, \hat{\theta}]$. For these types the budget constraints were binding under the original contract but not under the pooling contract. Thus, under the original contract principal's utility from contracting with these types is equal to:

$$V_D^{fc}(m^s(\theta), p^s(\theta)) = \theta_D G(m^s(\theta) - m_D)\sqrt{2p^s(\theta)} - p^s(\theta) \tag{A-21}$$

Since $\sqrt{2p^s(\theta)} < \theta G(m_A - m^s(\theta))$, notice that:

$$V_D^{nfc}(\theta, m^s(\theta), p^s(\theta)) = \theta_D \theta G(m^s(\theta) - m_D)G(m_A - m^s(\theta)) - p^s(\theta) \geq V_D^{fc}(m^s(\theta), p^s(\theta)) \tag{A-22}$$

Under the pooling contract principal 's utility from contracting with these types is equal to:

$$V_D^{nfc}(\theta, \tilde{m}, p^s(1)) = \theta_D \theta G(\tilde{m} - m_D)G(m_A - \tilde{m}) - p^s(1) \tag{A-23}$$

which, since $\tilde{m}$ maximizes $Y(\theta, m)$ and $p^s(1) < p^s(\theta)\ \forall\ \theta$, leads us to the following inequality:

$$V_D^{nfc}(\theta, \tilde{m}, p^s(1)) > V_D^{nfc}(\theta, m^s(\theta), p^s(\theta)) \geq V_D^{fc}(m^s(\theta), p^s(\theta)) \tag{A-24}$$

This proves that the principal is better off by offering the pooling contract $(\tilde{m}, p^s(1))$.

Now assume $\hat{\theta} < \overline{\theta}$. Using the same arguments as above, we know that principal's utility increases by offering the pooling contract to all types in the intervals $[0, \hat{\theta}]$ and $[\overline{\theta}, 1]$, since these types are either budget constrained or not under both contracts. It is left to check principal's utility for types in the interval $[\hat{\theta}, \overline{\theta}]$. These types are budget constrained under the pooling contract $(\tilde{m}, p^s(1))$ but not under the original contract. In the latter case, principal's utility from contracting with these types is given by $V_D^{nfc}(\theta, m^s(\theta), p^s(\theta))$. Notice that by step 2, $V_D^{nfc}(\theta, m^s(\theta), p^s(\theta))$ must be smaller than $V_D^{fc}(m^s(1), p^s(1))$ $\forall\ \theta \in [\hat{\theta}, \overline{\theta}]$. Then, the following inequality must hold:

$$V_D^{fc}(\tilde{m}, p^s(1)) > V_D^{fc}(m^s(1), p^s(1)) > V_D^{nfc}(\theta, m^s(\theta), p^s(\theta))$$

which proves that the principal is better off by offering the pooling contract $(\tilde{m}, p^s(1))$ also types in the interval $[\hat{\theta}, \overline{\theta}]$ rather than the original separating contract.

Last, suppose $m^s(1) > \tilde{m} > m^s(\overline{\theta})$ and that the principal offers the pooling contract $(\tilde{m}, p^s(1))$ to all types. Let again define by $\hat{\theta}$ the lowest type that is budget constrained under that pooling contract. It is easy to verify that $\hat{\theta} < \overline{\theta}$ and, using the same arguments as above, that the principal is better off than by offering the original separating contract.

Finally, similar arguments apply if the original contract is pooling in the interval in which the agents are budget constrained, i.e. if $m(\theta) = m^s(\overline{\theta})$ for all $\theta \in [\overline{\theta}, 1]$. Since agents $[\overline{\theta}, 1]$ are budget constrained, they all generate an utility to the principal that is equal to the utility generated by type $\overline{\theta}$. Similarly, types $[\overline{\theta}, 1]$ are also budget constrained under the pooling contract (m^p, p^p) defined in (A-13) and (A-14), and therefore they would all generate the same utility to the principal as type $\overline{\theta}$ under that contract. In Lemma 3 we saw that the principal gets a higher utility by offering that pooling contract to all types $[0, \overline{\theta}]$ - so including to type $\overline{\theta}$ - rather than any separating contract. Therefore, he also gets a higher utility by offering that same pooling contract to types $(\overline{\theta}, 1]$. This completes the proof of Lemma 5.

To summarize, Lemma 3 and 5 show that there always exists a pooling contract that gives the principal a higher utility than any (full or partial) separating contract with increasing $m(\theta)$. Lemma 1 and Lemma 4 show that a (full or partial) separating contract with decreasing $m(\theta)$ is never implementable. This leads to Proposition 6. More specifically, the optimal pooling contract solves:

$$\max_{m,p}\ \theta_D G(m - m_D)\Big[\Big(1 - F\Big(\frac{\sqrt{2p}}{G(m_A - m)}\Big)\Big)\sqrt{2p} + \int_0^{\frac{\sqrt{2p}}{G(m_A - m)}} \theta G(m_A - m) f(\theta) d\theta\Big] - p$$

which leads to the following FOCs:

$$G'(m - m_D)\Big(1 - F\Big(\frac{\sqrt{2p}}{G(m_A - m)}\Big)\Big)\sqrt{2p} +$$
$$[G'(m - m_D)G(m_A - m) - G(m - m_D)G'(m_A - m)] \int_0^{\frac{\sqrt{2p}}{G(m_A - m)}} \theta G(m_A - m) f(\theta) d\theta = 0$$

$$\theta_D G(m - m_D)\Big(1 - F\Big(\frac{\sqrt{2p}}{G(m_A - m)}\Big)\Big)\frac{1}{\sqrt{2p}} - 1 = 0 \qquad \text{(A-25)}$$

Notice that for (A-25) to be satisfied, the term $\left(1 - F\left(\frac{\sqrt{2p}}{G(m_A - m)}\right)\right)$, namely the probability of an agent to be budget constrained, must be higher than zero. This implies that under the optimal pooling contract some types are budget constrained.

Appendix B

Appendix: Chapter 3

Table B.1: Piece rate choices of principals with different survey responses

	(1)	(2)	(3)
	RE	Probit	RE
fair to pay lower wage	0.205*	0.574*	0.100
	(0.123)	(0.327)	(0.086)
constant	0.386***	–0.323	0.179**
	(0.093)	(0.271)	(0.070)
Round FE?	Yes	Yes	Yes
Session FE?	Yes	Yes	Yes
Individual FE?	No	No	No
Adj. R^2			
Observations	730	730	730

Standard errors are clustered at the individual level. Regression (1) and (2) include only observations within the main treatment and *open* contract. Regression (3) includes only observations within the main treatment and *closed* contract. The dependent variable is binary and takes value 1 if the offered piece rate is below 5 and value 0 otherwise. The independent variable is a dummy variable equal to 1 if, in the survey conducted at the end of the experiment, the principal reported that he would offer a lower wage to a motivated job candidate, and 0 otherwise. Significance levels: *** p<.01, ** p<.05, * p<.1.

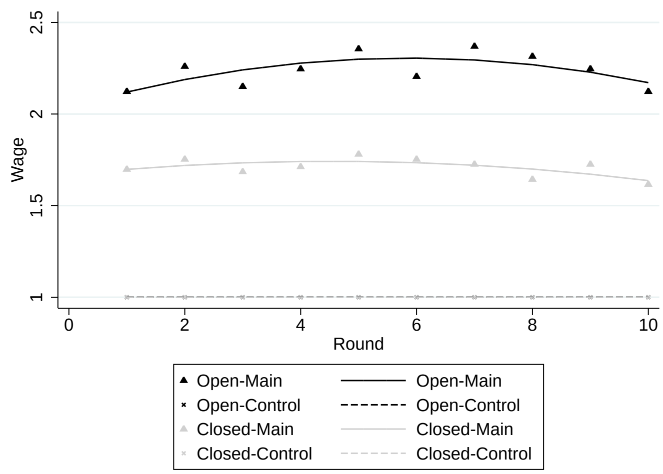

Figure B.1: **Effort over time for a piece rate**= 1. Averages shown by the dots for the respective type of contract and treatment, quadratic time trend shown by the lines for each type of contract and treatment. In total, 73 subjects participated in each type of contract and treatment.

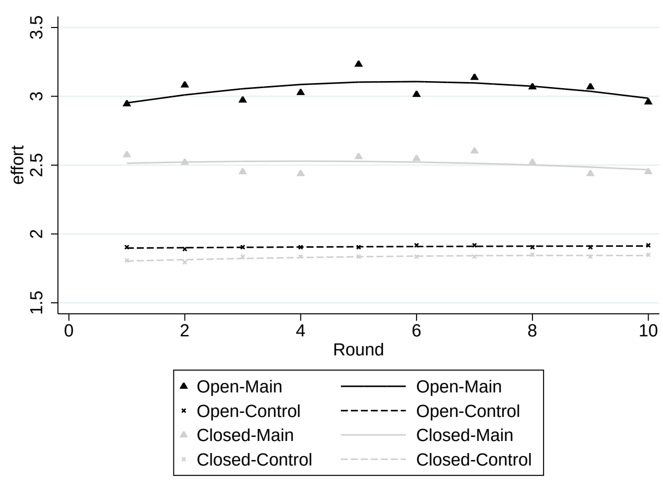

Figure B.2: **Effort over time for a piece rate**= 2. Averages shown by the dots for the respective type of contract and treatment, quadratic time trend shown by the lines for each type of contract and treatment. In total, 73 subjects participated in each type of contract and treatment.

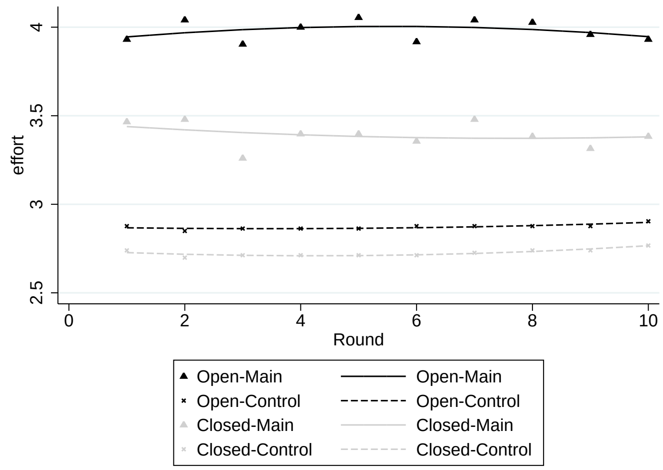

Figure B.3: **Effort over time for a piece rate**= 3. Averages shown by the dots for the respective type of contract and treatment, quadratic time trend shown by the lines for each type of contract and treatment. In total, 73 subjects participated in each type of contract and treatment.

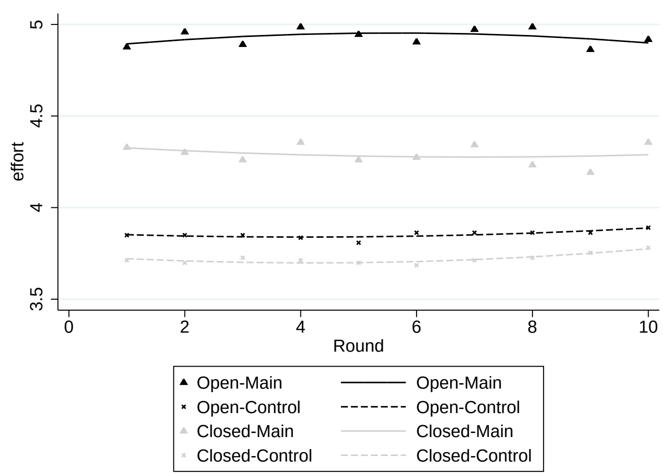

Figure B.4: **Effort over time for a piece rate**= 4. Averages shown by the dots for the respective type of contract and treatment, quadratic time trend shown by the lines for each type of contract and treatment. In total, 73 subjects participated in each type of contract and treatment.

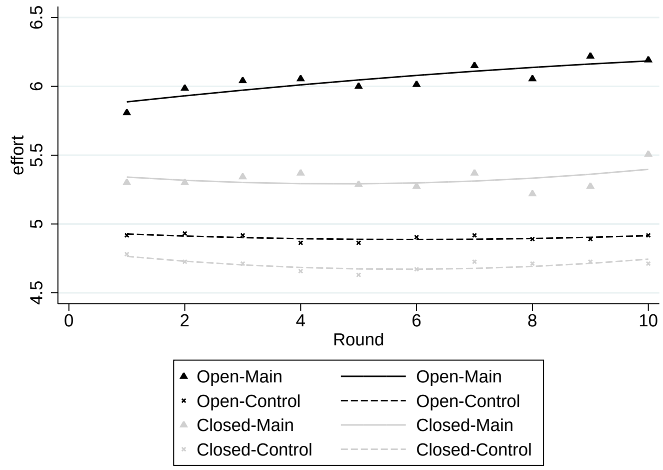

Figure B.5: **Effort over time for a piece rate**= 5. Averages shown by the dots for the respective type of contract and treatment, quadratic time trend shown by the lines for each type of contract and treatment. In total, 73 subjects participated in each type of contract and treatment.

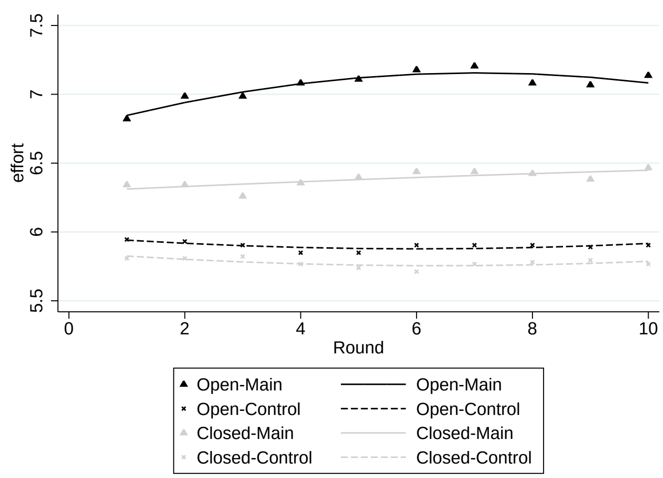

Figure B.6: **Effort over time for a piece rate**= 6. Averages shown by the dots for the respective type of contract and treatment, quadratic time trend shown by the lines for each type of contract and treatment. In total, 73 subjects participated in each type of contract and treatment.

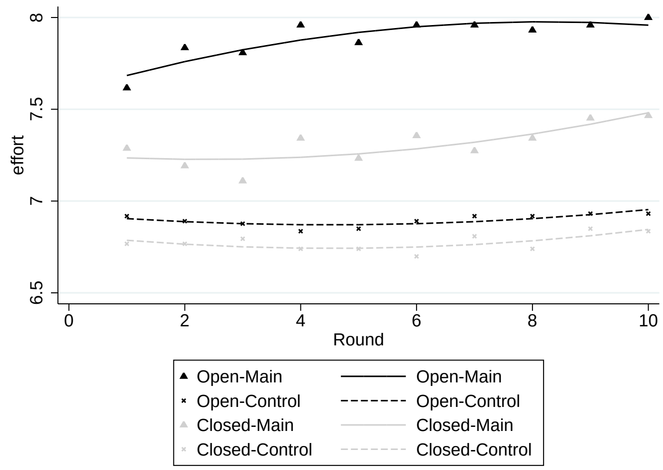

Figure B.7: **Effort over time for a piece rate**= 7. Averages shown by the dots for the respective type of contract and treatment, quadratic time trend shown by the lines for each type of contract and treatment. In total, 73 subjects participated in each type of contract and treatment.

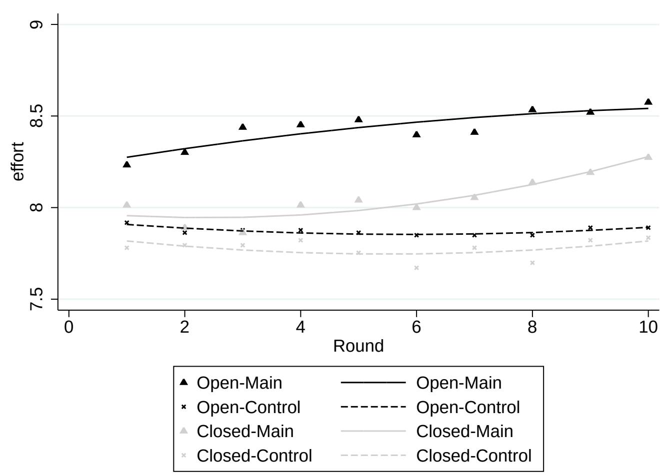

Figure B.8: **Effort over time for a piece rate**= 8. Averages shown by the dots for the respective type of contract and treatment, quadratic time trend shown by the lines for each type of contract and treatment. In total, 73 subjects participated in each type of contract and treatment.

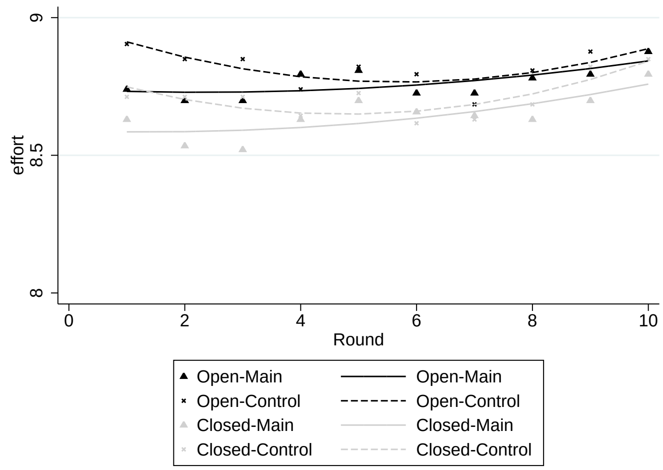

Figure B.9: **Effort over time for a piece rate**= 9. Averages shown by the dots for the respective type of contract and treatment, quadratic time trend shown by the lines for each type of contract and treatment. In total, 73 subjects participated in each type of contract and treatment.

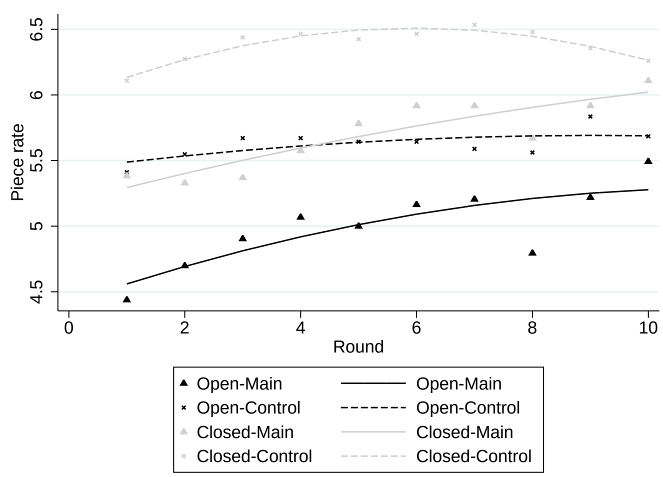

Figure B.10: **Piece rates over time**. Averages shown by the dots for the respective type of contract and treatment, quadratic time trend shown by the lines for each type of contract and treatment. In total, 73 subjects participated in each type of contract and treatment.

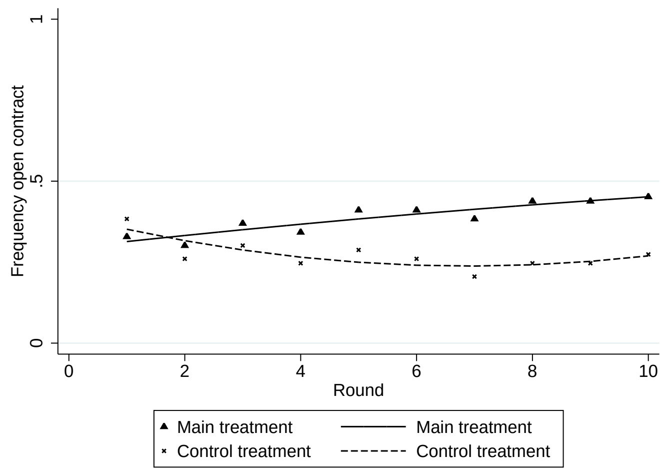

Figure B.11: **Contract choice over time**. Averages shown by the dots for the respective treatment, quadratic time trend shown by the lines for each treatment. In total, 73 subjects participated in each treatment.

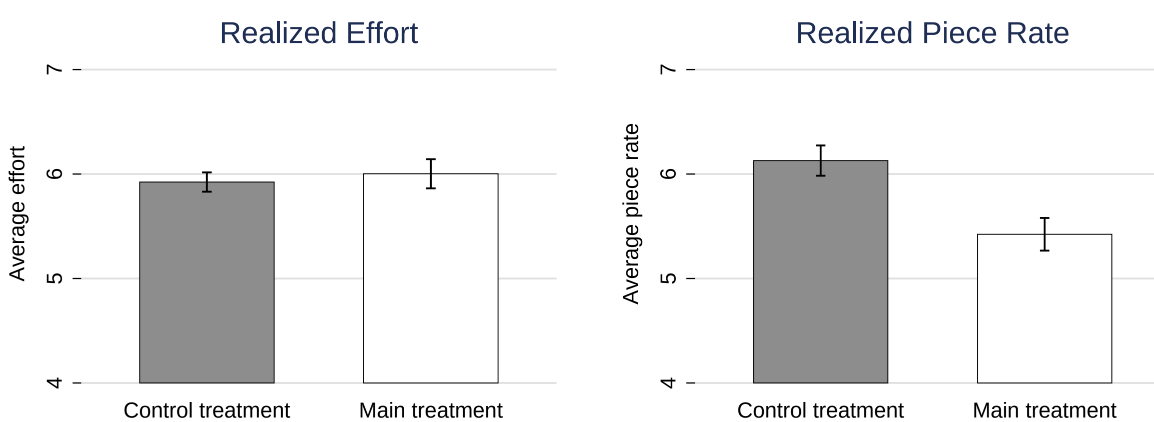

Figure B.12: Average realized effort and piece rate

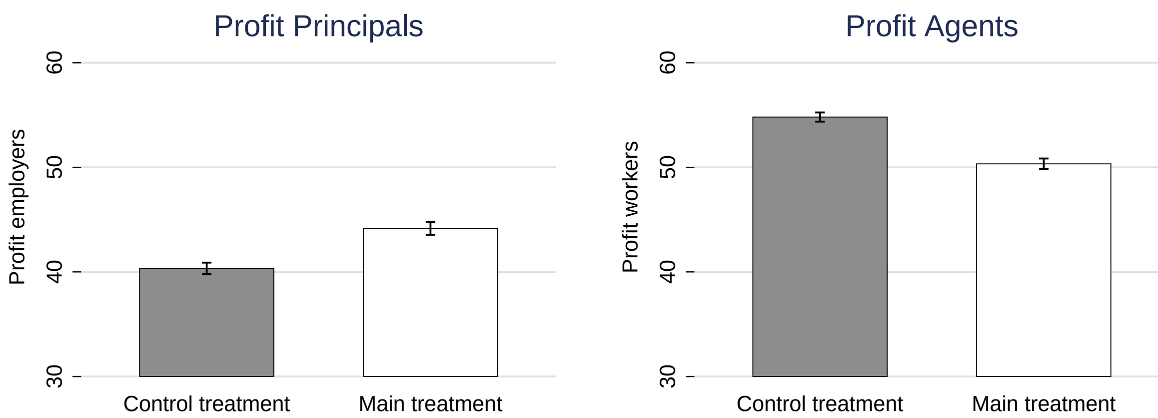

Figure B.13: Average realized profit

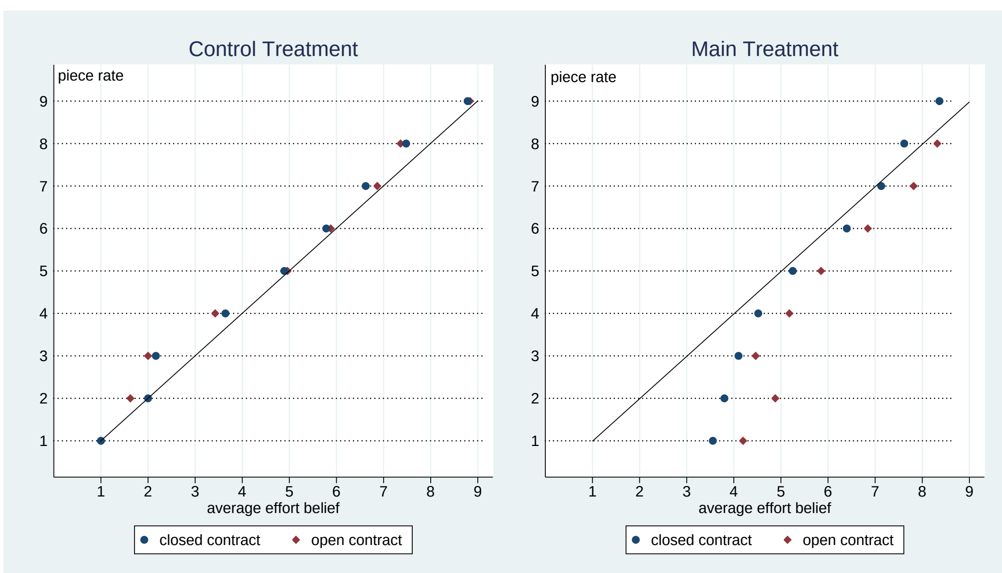

Figure B.14: Beliefs about effort

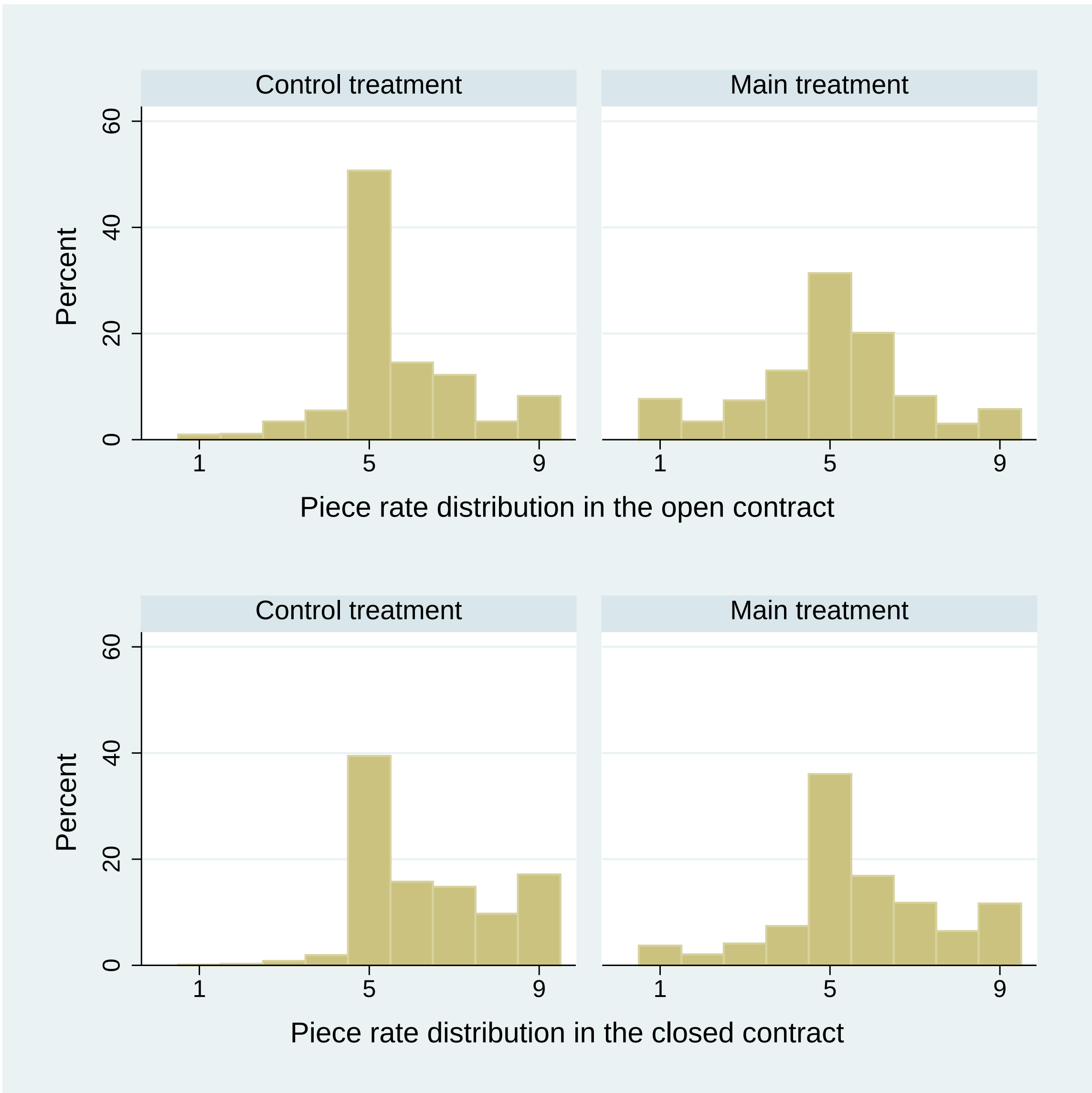

Figure B.15: Piece rate distribution

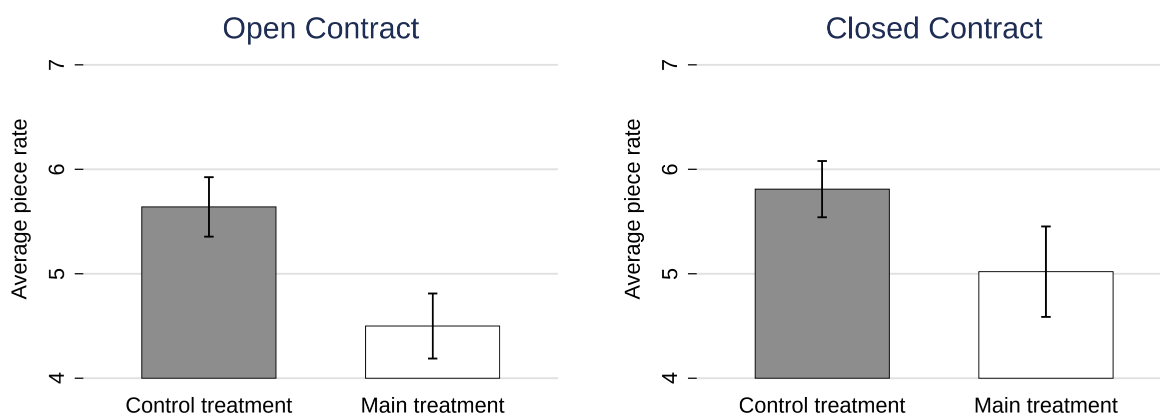

Figure B.16: **Piece rate difference across contracts for sub-sample of principals**. Average piece rate offered by 14% of principals ($n = 10$) who, in a survey conducted at the end of the experiment, said that they would offer a lower wage to motivated job candidate.

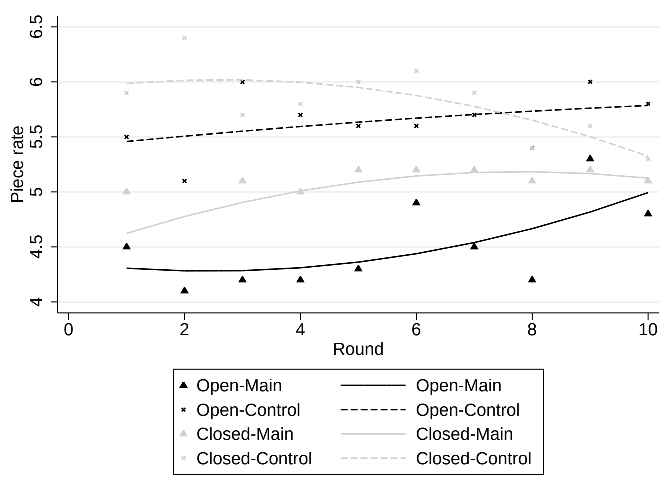

Figure B.17: **Piece rates over time for sub-sample of principals**. Averages shown by the dots for the respective type of contract and treatment, quadratic time trend shown by the lines for each type of contract and treatment. Only observations from the principals who, in the survey, reported that they would offer a lower wage to a motivated job candidate are included. In total, 10 subjects participated in each type of contract and treatment.

Appendix C

Appendix: Chapter 4

Table C.1: Effect of income generation on CHF distributed to LoLot

Control for effort	None	Linear	Quadratic	FE (10)	FE(5)	FE(2.5)
Constant	18.50***	20.86***	23.22***	16.93***	17.51***	17.21***
	(0.75)	(2.05)	(3.03)	(5.74)	(5.83)	(5.76)
LoTour	-2.09*	-2.44**	-2.19*	-1.93	-2.51*	-2.21*
	(1.07)	(1.11)	(1.13)	(1.17)	(1.27)	(1.30)
F-test contr. (p)		0.218	0.270	0.206	0.397	0.318
N	115	115	115	115	115	115
R^2	0.03	0.05	0.06	0.19	0.28	0.40
Adj. R^2	0.02	0.03	0.03	0.06	0.04	0.07

Ordinary least squares regressions. Dependent variable: CHF distributed to LoLot. Sample: LoLot and LoTour. FE(x) means fixed effects for effort bins of size x. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Standard errors in parentheses.

Table C.2: Effect of income generation on CHF distributed to LoTour

Control for effort	None	Linear	Quadratic	FE(10)	FE(5)	FE(2.5)
Constant	9.87***	15.50***	16.13***	12.31	13.31*	12.86
	(0.99)	(2.66)	(3.96)	(7.62)	(7.73)	(7.78)
LoTour	3.90***	3.06**	3.13**	2.69*	1.69	2.14
	(1.41)	(1.44)	(1.48)	(1.55)	(1.68)	(1.76)
F-test contr. (p)		0.025	0.080	0.258	0.438	0.496
N	115	115	115	115	115	115
R^2	0.06	0.10	0.11	0.21	0.29	0.39
Adj. R^2	0.05	0.09	0.08	0.08	0.06	0.05

Ordinary least squares regressions. Dependent variable: CHF distributed to LoTour. Sample: LoLot and LoTour. FE(x) means fixed effects for effort bins of size x. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Standard errors in parentheses.

Table C.3: Effect of income from effort on belief about tournament

Control for effort	None	Linear	Quadratic	FE(10)	FE(5)	FE(2.5)
Constant	4.46***	4.48***	5.68***	7.00***	7.00***	7.00***
	(0.27)	(0.77)	(1.25)	(1.96)	(1.94)	(1.97)
HiTour	-1.45***	-1.44***	-1.56***	-1.41***	-1.48***	-1.38**
	(0.38)	(0.46)	(0.47)	(0.49)	(0.52)	(0.58)
F-test contr. (p)		0.980	0.484	0.092	0.102	0.279
N	112	112	112	112	112	112
R^2	0.11	0.11	0.13	0.28	0.37	0.46
Adj. R^2	0.11	0.10	0.10	0.17	0.19	0.16

Ordinary least squares regressions. Dependent variable: Belief about luck dependence of tournament. Sample: HiTour and LoTour. FE(x) means fixed effects for effort bins of size x. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. Standard errors in parentheses.

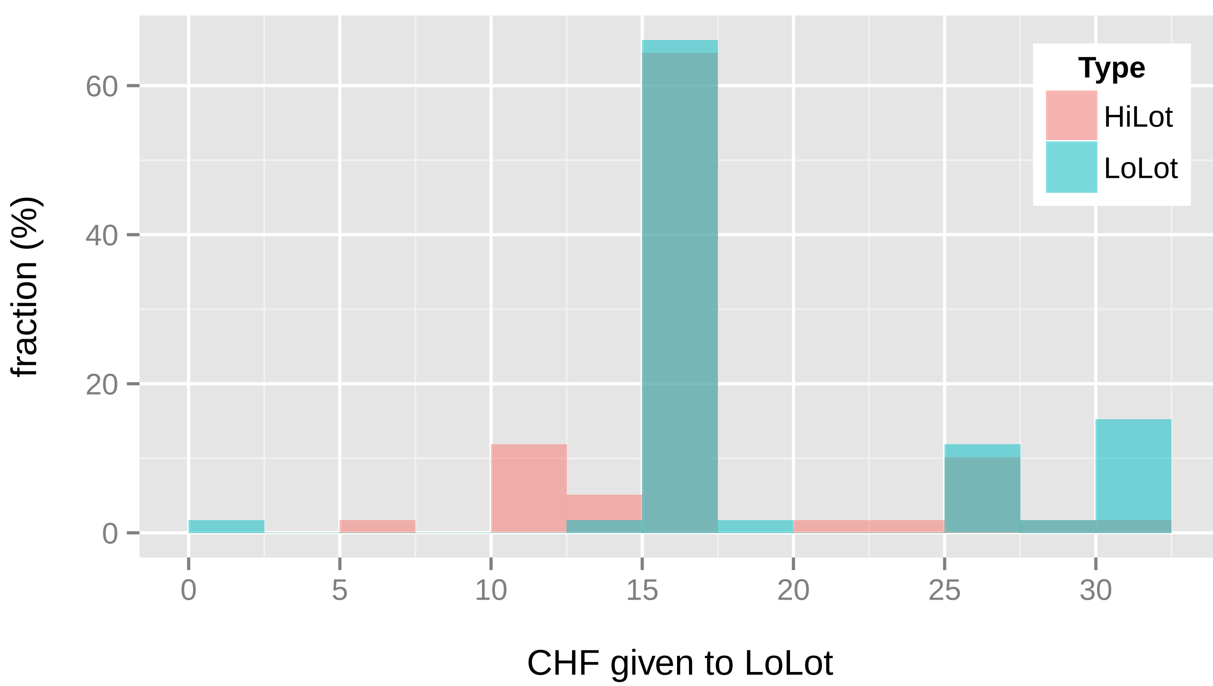

Figure C.1: Histograms of distributive decisions of HiLot and LoLot for pair from lottery

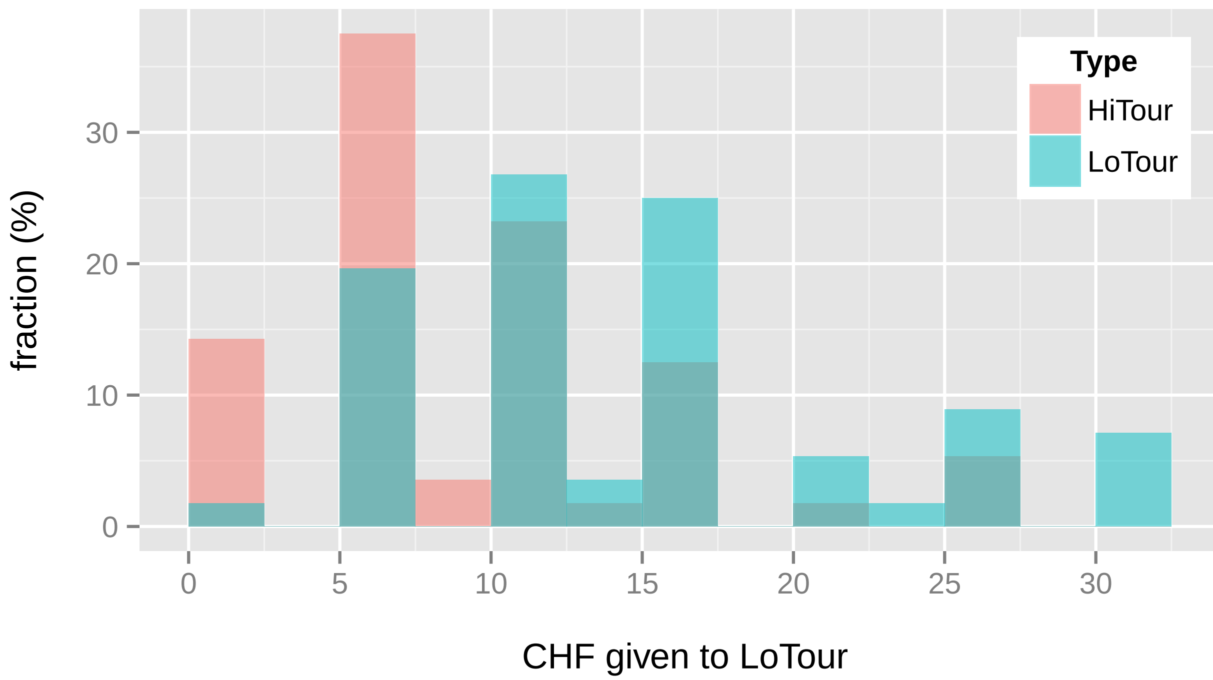

Figure C.2: Histograms of distributive decisions of HiTour and LoTour for pair from tournament

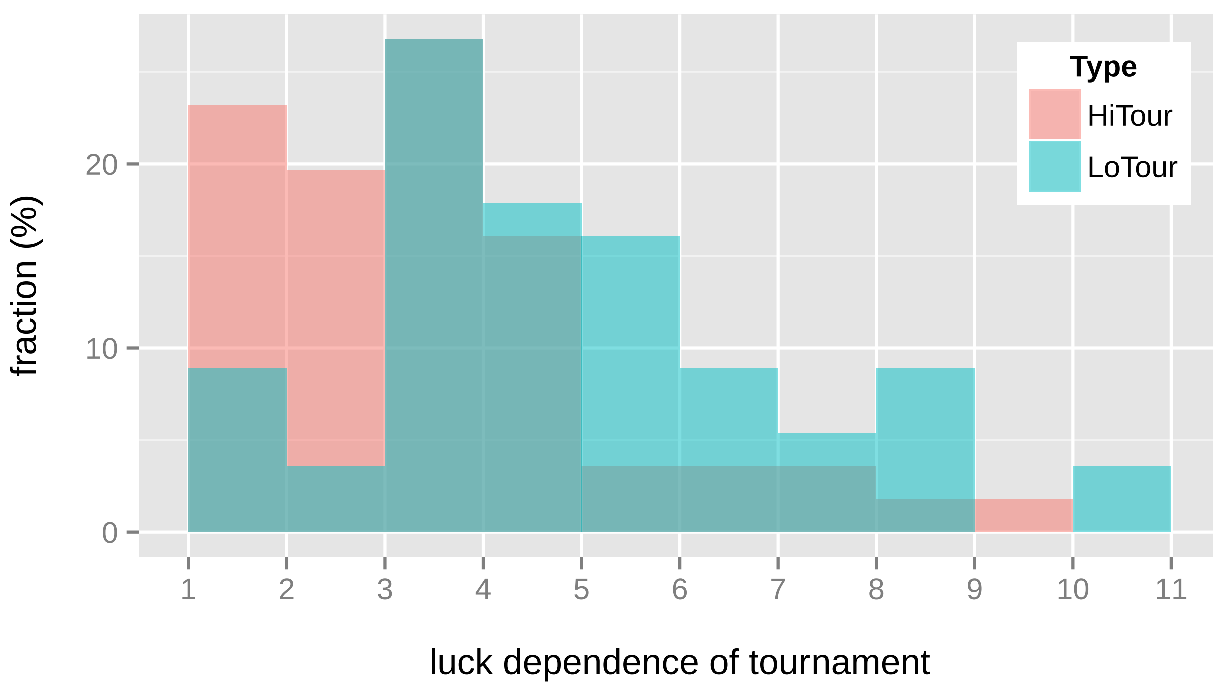

Figure C.3: Histograms of beliefs of HiTour and LoTour for tournament

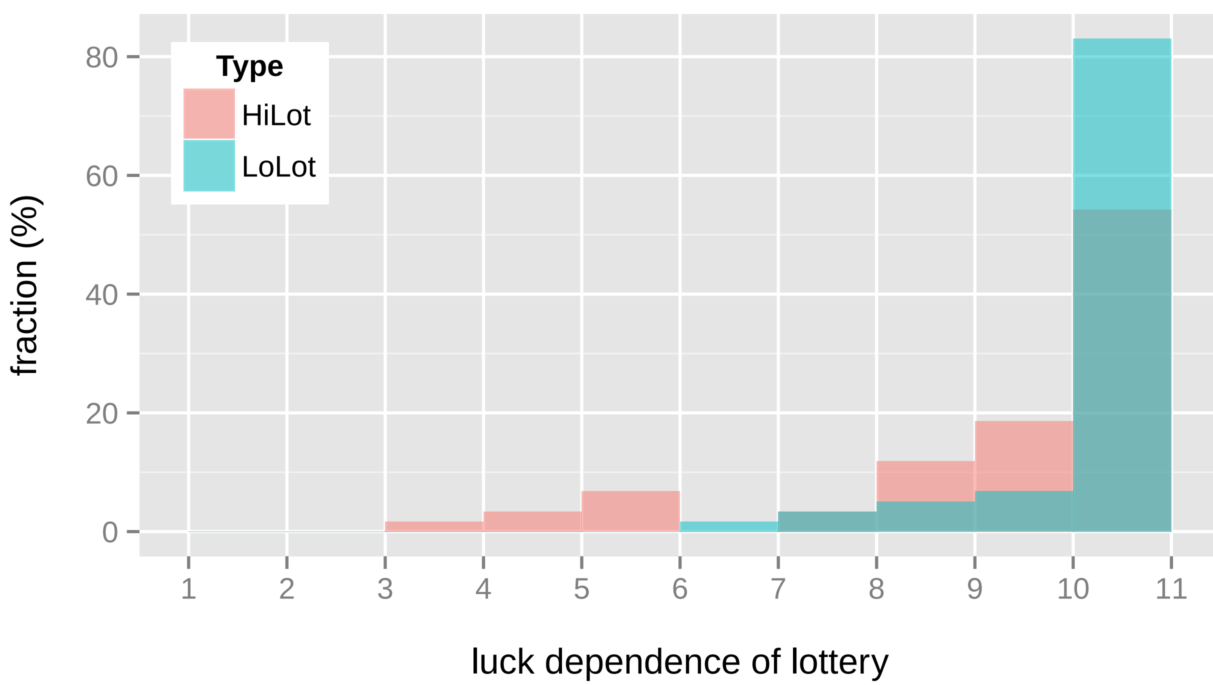

Figure C.4: Histograms of beliefs of HiLot and LoLot for lottery

References

Aghion, P. and J. Tirole (1997). Formal and real authority in organizations. *Journal of Political Economy 105*(1).

Agranov, M. and T. R. Palfrey (2014). Equilibrium tax rates and income redistribution: A laboratory study. NBER Working Paper No. 19918.

Akerlof, G. A. and R. E. Kranton (2005). Identity and the economics of organizations. *Journal of Economic Perspectives 19*(1), 9–32.

Akerlof, G. A. and R. E. Kranton (2008). Identity, supervision, and work groups. *American Economic Review 98*(2), 212–17.

Aldashev, G., E. Jaimovich, and T. Verdier (2013). When warm glow burns: Motivational (mis)allocation in the non-profit sector. Working paper.

Aldashev, G. and T. Verdier (2010). Goodwill bazaar: Ngo competition and giving to development. *Journal of Development Economics 91*(1), 48–63.

Alesina, A. and G.-M. Angeletos (2005). Fairness and redistribution. *The American Economic Review 95*(4), 960–980.

Alesina, A. and N. Fuchs-Schündeln (2007). Good-bye Lenin (or not?): The effect of communism on people's preferences. *The American Economic Review 97*(4), 1507–1528.

Alesina, A. and P. Giuliano (2011). Preferences for redistribution. In J. Benhabib, M. O. Jackson, and A. Bisin (Eds.), *Handbook of Social Economics*, Number Vol. 1A, pp. 93–131. Amsterdam: North-Holland.

Alesina, A. and E. La Ferrara (2005). Preferences for redistribution in the land of opportunities. *Journal of Public Economics 89*(5-6), 897–931.

Almås, I., A. W. Cappelen, E. Ø. Sørensen, and B. Tungodden (2010). Fairness and the development of inequality acceptance. *Science 328*(5982), 1176–1178.

Alonso, R. and N. Matouschek (2008). Optimal delegation. *The Review of Economic Studies 75*(1), pp. 259–293.

Armstrong, M. and J. Vickers (2010). A model of delegated project choice. *Econometrica 78*(1), 213–244.

Ashraf, N., O. Bandiera, and J. Kelsey (2014). No margin, no mission? a field experiment on incentives for pro-social tasks. *Journal of Public Economics*. Forthcoming.

Asker, J. and E. Cantillon (2010). Procurement when price and quality matter. *The RAND Journal of Economics 41*(1), pp. 1–34.

Bahney, B. W., R. K. Iyengar, P. B. Johnston, D. F. Jung, J. N. Shapiro, and H. J. Shatz (2013). Insurgent compensation: Evidence from iraq. *American Economic Review 103*(3), 518–22.

Barr, A., J. Burns, L. Miller, and I. Shaw (2012). Economic status and acknowledgment of earned entitlement. Working paper. Retrieved 2015/01/15, from http://blogg.nhh.no/thechoicelab/wp-content/uploads/2012/10/Barr+Burns+Miller+Shaw+10+Sept+2012+with +figures.pdf.

Bartling, B., E. Fehr, and K. M. Schmidt (2012). Screening, competition, and job design: Economic origins of good jobs. *American Economic Review 102*(2), 834–64.

Bartling, B., E. Fehr, and K. M. Schmidt (2013). Discretion, productivity, and work satisfaction. *Journal of Institutional and Theoretical Economics 169*(1), 4–22.

Becchetti, L., G. Degli Antoni, S. Ottone, and N. Solferino (2011). Spectators versus stakeholders with or without veil of ignorance: The difference it makes for justice and chosen distribution criteria. ECINEQ Working Paper No. 2011-204.

Benabou, R. and J. Tirole (2003). Intrinsic and extrinsic motivation. *The Review of Economic Studies 70*(3), pp. 489–520.

Benabou, R. and J. Tirole (2006). Incentives and prosocial behavior. *American Economic Review 96*(5), 1652–1678.

Besley, T. and M. Ghatak (1999). Public-private partnerships for the provision of public goods: Theory and an application to ngos. STICERD Development Economics Discussion Paper Series, DEDPS 17.

Besley, T. and M. Ghatak (2001). Government versus private ownership of public goods. *Quarterly Journal of Economics 116*(4), 1343–1372.

Besley, T. and M. Ghatak (2005). Competition and incentives with motivated agents. *American Economic Review 95*(3), 616–636.

Besley, T. and M. Ghatak (2006). Sorting with motivated agents: implications for school competition and teacher incentives. *Journal of the European Economic Association 4*(2-3), 404–414.

Besley, T. and M. Ghatak (2008). Status incentives. *American Economic Review 98*(2), 206–11.

Besley, T. and M. Ghatak (2013). Profit with Purpose? A Theory of Social Enterprise with Experimental Evidence. Working paper.

Bock, O., A. Nicklisch, and I. Baetge (2012a). hroot: Hamburg registration and organization online tool. H-Lab Working Paper No. 1.

Bock, O., A. Nicklisch, and I. Baetge (2012b). hroot: Hamburg registration and organization online tool. WiSo-HH Working Paper No. 1.

Bradley, G. W. (1978). Self-serving biases in the attribution process: A reexamination of the fact or fiction question. *Journal of Personality and Social Psychology 36*(1), 56–71.

Buckley, E. and R. Croson (2006). Income and wealth heterogeneity in the voluntary provision of linear public goods. *Journal of Public Economics 90*(4-5), 935–955.

Bullock, H. E., W. R. Williams, and W. M. Limbert (2003). Predicting support for welfare policies: The impact of attributions and beliefs about inequality. *Journal of Poverty 7*(3), 35–56.

Cappelen, A. W., A. D. Hole, E. Ø. Sørensen, and B. Tungodden (2007). The pluralism of fairness ideals: An experimental approach. *The American Economic Review 97*(3), 818–827.

Cappelen, A. W., J. Konow, E. Ø. Sørensen, and B. Tungodden (2013). Just luck: An experimental study of risk-taking and fairness. *The American Economic Review 103*(4), 1398–1413.

Cappelen, A. W., E. Ø. Sørensen, and B. Tungodden (2010). Responsibility for what? Fairness and individual responsibility. *European Economic Review 54*(3), 429–441.

Cardenas, J. C. and R. Sethi (2010). Resource allocation in public agencies: Experimental evidence. *Journal of Public Economic Theory 12*(4), 815–836.

Carpenter, J. and E. Gong (2013). Motivating agents: How much does the mission matter? IZA Working paper.

Cassar, L. (2014a). Job mission as a substitute for monetary incentives: Experimental evidence. Working paper.

Cassar, L. (2014b). Optimal contracting with endogenous project mission. Working paper.

Charness, G., R. Cobo-Reyes, N. Jimenez, J. A. Lacomba, and F. Lagos (2012). The hidden advantage of delegation: Pareto improvements in a gift exchange game. *American Economic Review 102*(5), 2358–79.

Chau, N. H. and M. Huysentruyt (2006). Nonprofits and public good provision: A contest based on compromises. *European Economic Review 50*(8), 1909–1935.

Che, Y. (1993). Design competition through multidimensional auctions. *RAND Journal of Economics 24*.

Che, Y.-K. and I. Gale (2003). Optimal design of research contests. *American Economic Review 93*(3), 646–671.

Costard, J. and F. Bolle (2011). Solidarity, responsibility and group identity. European University Viadrina Frankfurt (Oder), Department of Business Administration and Economics Discussion Paper No. 309.

Datta, S. and G. Satten (2005). Rank-sum tests for clustered data. *Journal of the American Statistical Association 471*(1), 908–915.

Datta, S. and G. Satten (2008). A signed-rank test for clustered data. *Biometrics 64*(2), 501–507.

Delfgaauw, J. and R. Dur (2007). Signaling and screening of workers' motivation. *Journal of Economic Behavior & Organization 62*(4), 605–624.

Delfgaauw, J. and R. Dur (2008). Incentives and workers' motivation in the public sector. *Economic Journal 118*(525), 171–191.

Durante, R., L. Putterman, and J. van der Weele (2014). Preferences for redistribution and perception of fairness: An experimental study. *Journal of the European Economic Association 12*(4), 1059–1086.

Englmaier, F. and S. Leider (2012). Contractual and organizational structure with reciprocal agents. *American Economic Journal: Microeconomics 4*(2), 146–83.

Erkal, N., L. Gangadharan, and N. Nikiforakis (2011). Relative earnings and giving in a real-effort experiment. *The American Economic Review 101*(7), 3330–3348.

Falk, A. and M. Kosfeld (2006). The hidden costs of control. *The American Economic Review 96*(5), pp. 1611–1630.

Fehr, E., H. Herz, and T. Wilkening (2013). The lure of authority: Motivation and incentive effects of power. *American Economic Review 103*(4), 1325–59.

Fehr, E., A. Klein, and K. M. Schmidt (2007). Fairness and contract design. *Econometrica 75*(1), 121–154.

Fehr, E. and K. M. Schmidt (1999, August). A Theory Of Fairness, Competition, And Cooperation. *The Quarterly Journal of Economics 114*(3), 817–868.

Fehrler, S. and M. Kosfeld (2013). Pro-social missions and worker motivation: An experimental study. Forthcoming in Journal of Economics Behavior and Organization.

Fischbacher, U. (2007a). z-Tree: Zurich Toolbox for Ready-made Economic Experiments.

Experimental Economics 10, 171–178.

Fischbacher, U. (2007b). z-tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics 10*(2), 171–178.

Fong, C. (2001). Social preferences, self-interest, and the demand for redistribution. *Journal of Public Economics 82*(2), 225–246.

Francois, P. (2003). Not-for-profit provision of public services. *The Economic Journal 113*(486), 53–61.

Francois, P. and M. Vlassopoulos (2008). Pro-social motivation and the delivery of social services. *CESifo Economic Studies 54*(1), 22–54.

Frankel, A. (2014). Aligned delegation. *American Economic Review 104*(1), 66–83.

Frohlich, N., J. Oppenheimer, and A. Kurki (2004). Modeling other-regarding preferences and an experimental test. *Public Choice 119*(1-2), 91–117.

Gerhards, L. (2013). How (not) to incentivize motivated agents - an expeirment with employees from a non-profit organization. Working paper.

Ghatak, M. and H. Mueller (2011). Thanks for nothing? not-for-profits and motivated agents. *Journal of Public Economics 95*(1-2), 94–105.

Ghatak, M. and H. Mueller (2013). Not-for-profits, for-profits and competition. Working paper.

Gill, D. and V. Prowse (2012). A structural analysis of disappointment aversion in a real effort competition. *The American Economic Review 102*(1), 469–503.

Giuliano, P. and A. Spilimbergo (2014). Growing up in a recession. *Review of Economic Studies 81*(2), 787–817.

Gurdal, M. Y., J. B. Miller, and A. Rustichini (2013). Why blame? *Journal of Political Economy 121*(6), 1205–1247.

Holmstrom, B. (1984). On the theory of delegation. In M. Boyer and R. Kihlstrom (Eds.), *Bayesian Models in Economic Theory*. Amsterdam: Elsvier.

Huysentruyt, M. (2011). Development aid by contract: Outsourcing and contractor identity. Working paper.

Isaksson, A.-S. and A. Lindskog (2009). Preferences for redistribution – A country comparison of fairness judgements. *Journal of Economic Behavior & Organization 72*(3), 884–902.

James, R. N. and D. L. Sharpe (2007). The nature and causes of the U-shaped charitable giving profile. *Nonprofit and Voluntary Sector Quarterly 36*(2), 218–238.

Kahneman, D., J. L. Knetsch, and R. Thaler (1986). Fairness as a Constraint on Profit Seeking: Entitlements in the Market. *American Economic Review, American Economic Association 76*(4), 728–41.

Kataria, M. and N. Montinari (2012). Risk, entitlements and fairness bias: Explaining preferences for redistribution in multi-person setting. Jena Economic Research Paper No. 2012,061.

Klor, E. F. and M. Shayo (2010). Social identity and preferences over redistribution. *Journal of Public Economics 94*(3-4), 269–278.

Koppel, H. and T. Regner (2013). Corporate social responsibility in the work place - experimental evidence on csr from a gift-exchange game. Working Paper.

Kosfeld, M. and S. Neckermann (2011). Getting more work for nothing? symbolic awards and worker performance. *American Economic Journal: Microeconomics 3*(3), 86–99.

Kosfeld, M., S. Neckermann, and X. Yang (2014). Profit with Purpose? A Theory of Social Enterprise with Experimental Evidence. Working paper.

Kosfeld, M. and F. von Siemens (2011). Competition, cooperation, and corporate culture. *The RAND Journal of Economics 42*(1), pp. 23–43.

Krawczyk, M. (2010). A glimpse through the veil of ignorance: Equality of opportunity and support for redistribution. *Journal of Public Economics 94*(1-2), 131–141.

Laffont, J.-J. and J. Tirole (1987). Auctioning incentive contracts. *Journal of Political Economy 95*(5), 921–37.

Luttmer, E. F. P. (2001). Group loyalty and the taste for redistribution. *Journal of Political Economy 109*(3), 500–528.

Luttmer, E. F. P. and M. Singhal (2011). Culture, context, and the taste for redistribution. *American Economic Journal: Economic Policy 3*(1), 157–179.

McAfee, R. P. and J. McMillan (1987). Competition for agency contracts. *RAND Journal of Economics 18*(2), 296–307.

Miller, D. T. and M. Ross (1975). Self-serving biases in the attribution of causality: Fact or fiction? *Psychological Bulletin 82*(2), 213–225.

Möllerström, J., B.-A. Reme, and E. Ø. Sørensen (2014). Luck, choice and responsibility: An experimental study of fairness views. Research Institute of Industrial Economics Working Paper No. 1014.

Murdock, K. (2002). Intrinsic motivation and optimal incentive contracts. *The RAND Journal of Economics 33*(4), pp. 650–671.

Myerson, R. B. (1981). Optimal auction design. *Mathematics of Operations Research 6*(1), 58–73.

Nyborg, K. (2014). Is corporate social responsibility associated with lower wages? *IZA World of Labor*.

Nyborg, K. and T. Zhang (2013). Is corporate social responsibility associated with lower wages? *Environmental and Resource Economics 55*(1), 107–117.

Owens, L. A. and D. S. Pedulla (2014). Material welfare and changing political preferences: The case of support for redistributive social policies. *Social Forces 92*(3), 1087–1113.

Perry, J., A. Hondeghem, and L. Wise (2010). Revisiting the motivational bases of public service: twenty years of research and an agenda of the future. *Public Administration Review 70*(5), 681–690.

Piff, P. K., M. W. Kraus, S. Côté, B. H. Cheng, and D. Keltner (2010). Having less, giving more: The influence of social class on prosocial behavior. *Journal of Personality and Social Psychology 99*(5), 771–784.

Piketty, T. (1995). Social mobility and redistributive politics. *The Quarterly Journal of Economics 110*(3), 551–584.

Pischke, J.-S. (2011). Money and happiness: Evidence from the industry wage structure. NBER Working Paper No. 17056.

Powdthavee, N. and A. J. Oswald (2014). Does money make people right-wing and inegalitarian? A longitudinal study of lottery winners. IZA Discussion Paper No. 7934.

Prendergast, C. (2007). The motivation and bias of bureaucrats. *American Economic Review 97*(1), 180–196.

Prendergast, C. (2008). Intrinsic motivation and incentives. *American Economic Review 98*(2), 201–05.

Rodriguez-Lara, I. and L. Moreno-Garrido (2012). Self-interest and fairness: Self-serving choices of justice principles. *Experimental Economics 15*(1), 158–175.

Rustichini, A. and A. Vostroknutov (2014). Merit and justice: An experimental analysis of attitude to inequality. *PLoS ONE 9*(12), e114512.

Tokumaru, N. (2014). Fairness ideals, hidden selfishness and opportunist behavior: An experimental approach. Kyoto University, Graduate School of Economics, Research Project Center Discussion Paper No. E-14-004.

Tonin, M. and M. Vlassopoulos (2014). Corporate Philanthropy and Productivity: Evidence from an Online Real Effort Experiment. Working paper.

Ubeda, P. (2014). The consistency of fairness rules: An experimental study. *Journal of Economic Psychology 41*, 88–100.

Vostroknutov, A., P. N. Tobler, and A. Rustichini (2012). Causes of social reward differences encoded in human brain. *Journal of Neurophysiology 107*(5), 1403–1412.

Curriculum vitae

Personal details

Lea Cassar	
Date of birth:	24 September 1983

Education

February 10 – July 15:	Doctoral program at the University of Zurich, Department of Economics, Chair of Behavioral Economics
February 15 – July 15 :	Visiting fellow at the Columbia Business School
November 14 :	Visiting fellow at the Rady School of Management, UCSD
January 05 – December 06:	Master of Science in Economics and Finance, LUISS University
September 03 – December 03:	Visiting student at Maastricht University
September 01 – December 04:	Bachelor of Arts in Business Administration, LUISS University